

SCIENCE

[Entered at the Post-Office of New York, N. Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

SEVENTH YEAR.
VOL. XIII. No. 328.

NEW YORK, MAY 17, 1889.

SINGLE COPIES, TEN CENTS.
\$3.50 PER YEAR, IN ADVANCE.

AMATEUR PHOTOGRAPHY AND ITS POSSIBILITIES.

AN opportunity is furnished by photography for beautiful picture-making, not only in original conception, but in imitation.

Take some fine head painted by an old master, study the light and shade upon it, the character of the face, the quality of the background. Then choose from among your friends one whose type is somewhat like that of the one in the picture, and arrange with great care the light on head and face, and neck and shoulders. The arrangement of each detail of the drapery is also important; and, with such care, there is nothing to prevent your getting an interesting negative. If there is a dimness over the picture, and you want to carry out even that idea, you can do so by putting your lens slightly out of focus. That will eliminate some of the detail, and produce the desired softness and dimness.

Try the same person in many poses, if you can get some one to sit for you who will willingly lend himself for a time to your experiments. Try a head somewhat like the one in Fig. 2 in various positions, — bent down, as is this, as if in meditation or prayer, with a strong side-light on the face, no reflected light on the head, and the whole against a gray background. Then try the same head upturned in profile, with no reflected light, and with a black background. Then, again, try a full face, with strong light and shade, and with a different background still, and see how much you have made from the same person.

You can produce quite different effects by the careful management of the light from one high side-light, either using the upper half of the window by curtaining the lower half, or using the lower

half and having a direct side-light upon your sitter; or, yet again, by leaving the whole window uncurtained. You must always be very careful about reflected lights, which are an important part of picture-making. One way of reflecting is by arranging a screen on the shadow-side of your sitter, and throwing over that a sheet. By putting the screen, so arranged, very near to the sitter, you will get a full, even, reflected light. By moving it away, a lesser light will be cast over the shadow of the face. Sometimes a looking-glass is used; but that produces an unnatural light, which is not so desirable as the reflection from a duller surface. There is a very easy way of throwing a little light under the brow and nose and chin. It may be done by laying a card or an open book in the lap of the sitter, or by asking him to hold one in the right position. Do not be afraid, however, of shadows. Learn to manage them skilfully, making them heavy enough to give force and character where needed, and light enough to bring out delicate lines in their places.

Try now to imitate, in part or in detail, a Holbein portrait of a child. Arrange your light as in the chosen picture; and if the

child have a fair, smooth skin, a most charming effect of finished surface can be made with a mellow, rich light flooding the little



FIG. 1. — PORTRAIT OF A CHILD, AFTER HOLBEIN'S METHOD.

face. Fig. 1 is somewhat after Holbein's method, although no particular picture was chosen for imitation. This photograph was taken in a bay-window with a great deal of light. The child's skin was very fair and smooth, the eyes a hazel, every feature very clearly cut. An old-fashioned dress was chosen; and were it not for the shadow on the neck, which is much too dark, the idea I had in mind was quite fairly carried out. Always there is danger that some point will be overlooked in the arranging, some spot of light or shade forgotten, and there is where much thought is needed. Think your picture well out beforehand, so as not to keep the sitter unnecessarily long. When the time arrives for the taking, arrange quickly and deftly your subject, having the means

was developed and I took it out into the light of day, "Oh! ain't I a pretty little thing?" She was surely a very smiling, good little child, as she sat for the picture.

It is not necessary to keep to heads in this matter of imitation. Try figures and groups, if you like. But the more you have in your picture, the more difficult it will be. The best way is to begin with a head, simply lighted, and work with that until you get a fair imitation of some good picture.

If you have a quick-working lens, try a picture with a baby in it. This is an ambitious thing to do. But take one of Andrea del Sarto's pictures of the "Madonna and Child," and plan to make a photograph as nearly like it as possible. One sometimes sees

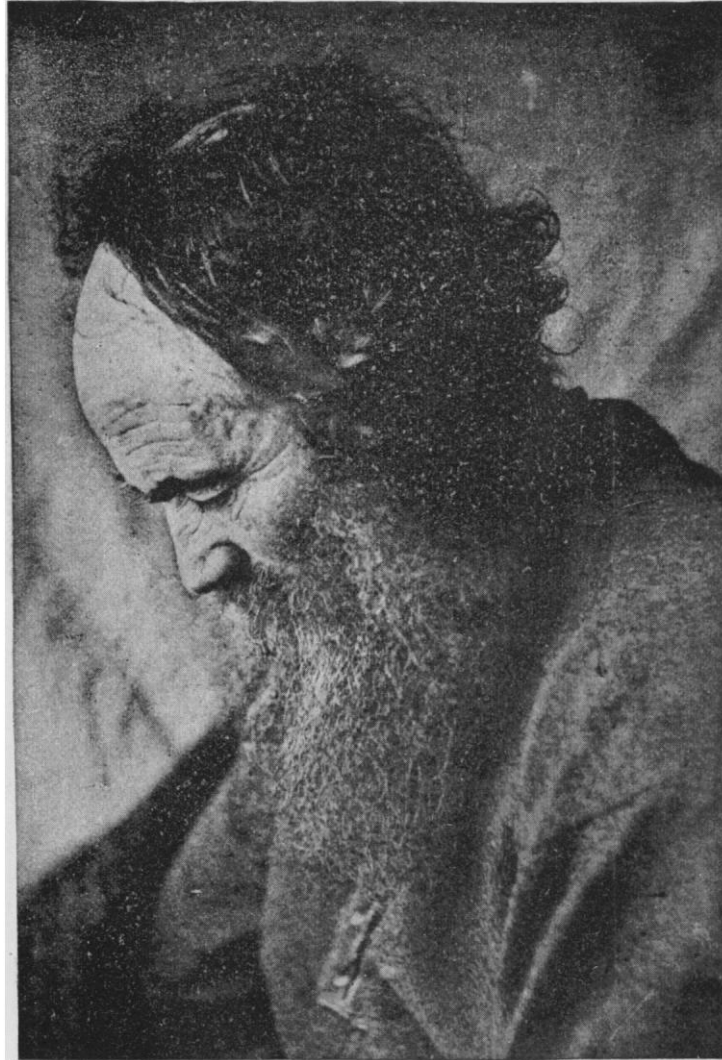


FIG. 2.

of reflecting light and darkening background near at hand, your camera in good order, your lens clean. Then hope for the best, and take off the cap. Always there are disappointments in store. It would be strange were there not. But also there is the certainty of making the disappointments less by sufficient care.

From the older painters, come down a few centuries to more modern ones. Take, for instance, one of Sir Joshua Reynolds's pictures of a child. Here, indeed, is a charming field for you to enter upon. Fig. 3 is taken somewhat after the manner of Sir Joshua. It is by no means a direct imitation, but some of his pictures were in my mind at the time, and half seriously it has been called "After Sir Joshua" by several friends. It was hastily taken, in a poor side-light. The dress was improvised at the moment. The child was an amiable little sitter, and, in a quite unconscious way, much pleased with the result, remarking, when the negative

faces of the Madonna type, — gentle, mild-eyed women, with pure, delicately cut features. Have the woman dressed like the one in your picture; the lights, backgrounds, and all accessories carefully arranged, except the little child, who should be introduced at the last moment, and posed as nearly as possible like the child in the picture. Then focus quickly, and take your picture. You should do this thing very well, or not at all. It needs great skill; and a careful study of composition and light and shade should go first.

There are charming Van Dykes to imitate, Rembrandts, Holbeins, Andrea del Sartos, Copleys, and Stuarts. There are also some exquisite modern pictures which it would do you no harm to study. If you are an art-student, you can help your art very much by studying pictures in this way. You will learn how persons far wiser than you, have managed their light and shade, how beatifully

they have posed their subjects, how they have taken thought of every important line.

This of which I have written is a branch of photography which has been but little attempted, and it is certainly worth notice; worth entering upon, if your taste leads you in this way, with earnestness and enthusiasm.

LAURA M. MARQUAND.

IMPROVEMENTS IN THE BENTLEY-KNIGHT ELECTRIC RAILWAY SYSTEM.

IN *Science* of Jan. 18 we described the electric railway on Observatory Hill, Allegheny City, Penn., equipped by the Bentley-Knight Company, and illustrated the motor trucks in use on that line. In this number we give a plan and elevation of a double-

from the wheels. The spring support makes the wear less, while allowing the motors to give a yielding impact to the load at starting. The commutator-brushes are fixed in position when the motor is first adjusted, and need no further adjustment.

While the Bentley-Knight Company has paid considerable attention to conduit construction, and has laid and operated successfully such systems, and claims to control that system by many patents, it is a mistaken idea to believe that it confines its attention to such lines; the Allegheny City line being, in part at least, an elevated-conductor road. The grades, curves, and general difficulties of that road we have already referred to. In Boston, the Bentley-Knight motors, while running over three miles of conduit, are also running over twelve miles of elevated conductors. This company has lately taken the contract for the Port Chester, White Plains, and Tarrytown Street Railway, crossing Westchester



FIG. 3.

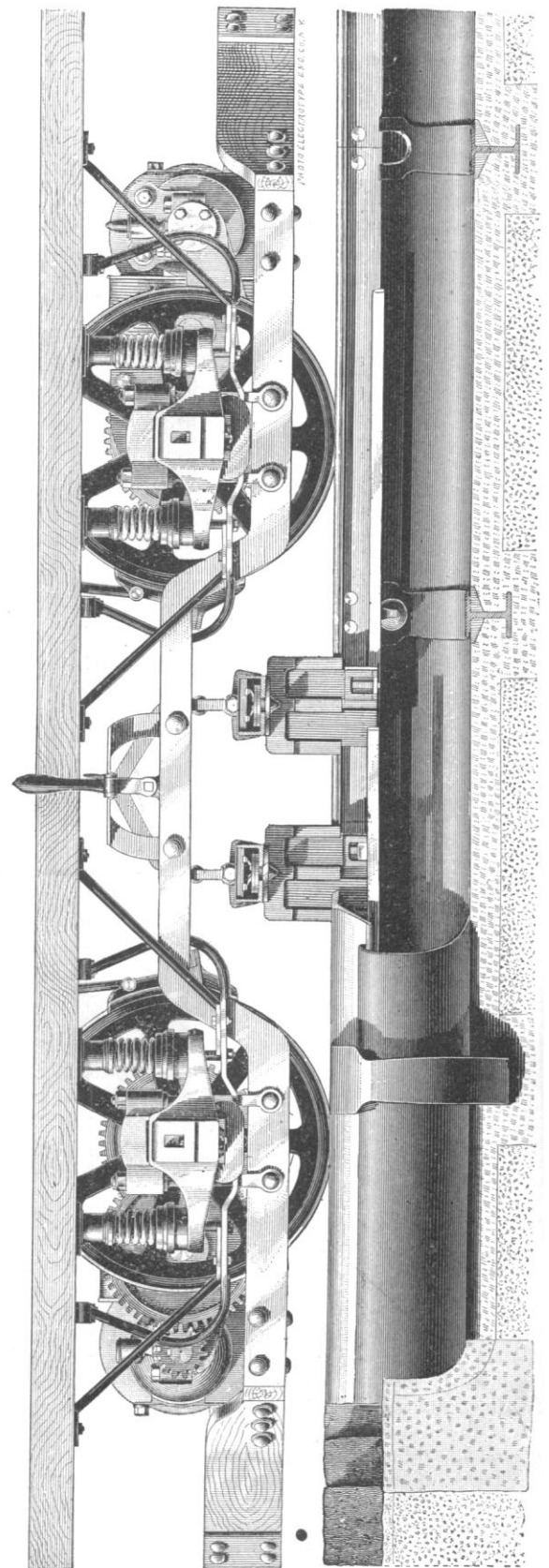
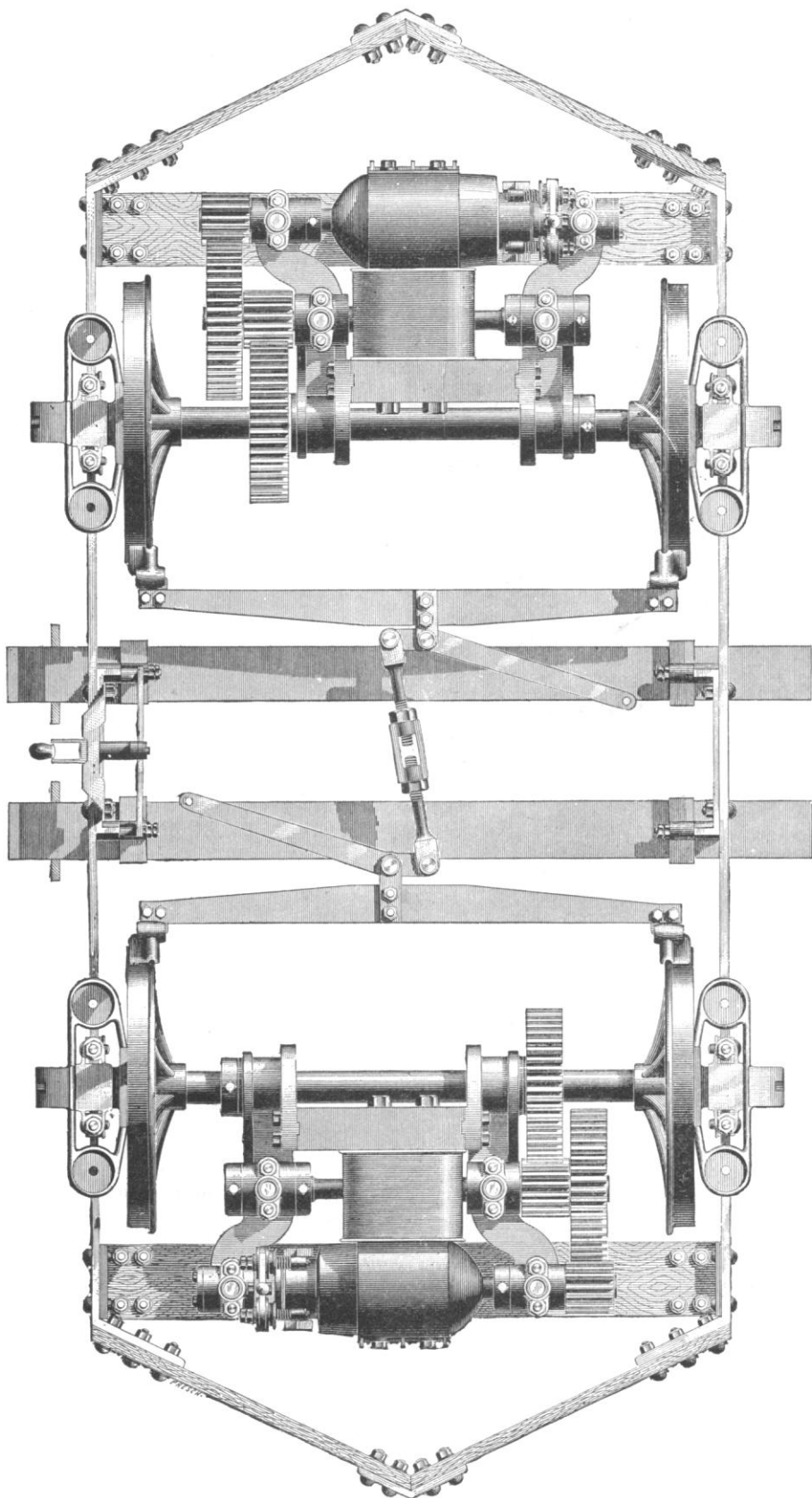
motor truck, which is considered an improvement on that previously described, and which is now in use on the West End Street Railway Company's line in Boston (see p. 374).

Each motor is of fifteen horse-power. The trucks are the heaviest yet built and operated for electric tramway service, and are used to pull two cars on week days, and three cars on Sundays. They are equally well adapted for use with elevated conductors or with the conduit system, although our illustration shows them as equipped for the latter. The insulation has been carried to a high point. The truck is independent of the car-body, and goes under any ordinary car without alteration and without raising a car above its ordinary height. Control is effected by a lever on the front platform. The reversal of the car may be instantly effected, and during this reversal the current is automatically cut off.

As is seen by the illustration, the motors themselves, together with all gearing, are supported outside between the spaces of the axles of the car, giving ease in getting at the wearing parts, and enabling the motors to be carried in a position where they are least in the way, and least exposed to splashes of mud and water

County, upon which line heavy double-motor trucks, similar to the one described in this number, will be employed.

THE June number of *The Chautauquan* presents a wide variety of topics in its table of contents. William P. Trent, M.A., of the University of the South, discusses "The Position of Women in Ancient Greece;" the ninth in the series of Greek biographical sketches by Thomas D. Seymour, M.A., of Yale University, has for its subject "Ptolemy Soter;" Russell Sturgis finishes his two-part paper on "The Archæologist in Greece;" the Rev. J. G. Wood describes some "Odd Fishes;" Albert Shaw, Ph.D., contributes an article on "European Town Life;" Professor Charles J. Little, LL.D., of Syracuse University, concludes his two-part paper on "The Paris Mob and its Achievements;" the Hon. A. B. Richmond denounces the "license curse" in "The Relation of Rum to Crime;" Mrs. Carl Barus writes entertainingly of "Oriental Legations at Washington;" and Ripley Hitchcock recounts his experiences "At the Head of the Rails" in the Black Cañon of the Gunnison.



THE BENTLEY-KNIGHT DOUBLE-MOTOR TRUCK, ELEVATION AND PLAN. [See preceding page.]

RAILWAYS IN CHINA.

EVER since the opening of the treaty ports, the attention of foreigners in China has been attracted to the development of the means of intercommunication in a country where the engineering difficulties to be encountered are comparatively small. The frequent recurrence of famine over the vast area of China, the enormous difficulties of transport with the consequent delay and uncertainty in conveying relief, and the increased price of all commodities in a ratio out of all proportion to the distance from the area of production, offered such strong arguments for the introduction of railways, that it seemed impossible even for Chinese prejudice to withstand them, provided any feasible scheme could be produced. The history of railways in China is given in the May number of *The Contemporary Review*, in an article by Mr. Charles S. Addis. The most practical method appeared to be by way of demonstration, and accordingly a small line was constructed between Shanghai and Wusung, a distance of thirteen miles. In December, 1876, the line was opened for traffic under a convention between the governments of Great Britain and China, and for some time met with a fair measure of success. From December to October, 175,995 tickets were issued, and the sum of \$38,258.78 was realized by their sale. Happily no casualty of any kind happened to passengers, and the promoters of the railway had reason to congratulate themselves on the complete success of their undertaking. But they had underestimated the intense conservatism of the Chinese character, the dislike which such an innovation was sure to arouse among a nation profoundly affected by an ancient system of geomancy, and imbued with a traditional reverence for the places of the dead, and, above all, the opposition to be encountered from the host of carriers by road and canal, already jealous of the slightest interference with their means of livelihood. With such potent influences arrayed against it, the railway bantling could hardly be long-lived. It lasted barely a year. On Oct. 20, 1877, the Chinese authorities purchased the line. The rails were torn up, the permanent way was destroyed, and the remains of the first railway in China are now lying rusting on the Formosan beach.

Meanwhile events had been moving rapidly. China had formally entered the comity of nations. Her political relations with foreign powers were becoming closer and more involved. Emigrants were annually departing from her shores in increasing numbers to Australasia, the Straits Settlements, the United States, and Peru, and their care formed an additional and growing tax upon the resources of Chinese diplomacy. The national cohesion could not long withstand the disintegrating processes at work, and the barriers of ancient exclusiveness were crumbling away as surely and more rapidly than the Great Wall itself. It became necessary to appoint ambassadors and consuls at foreign courts and at those places where large numbers of Chinese subjects had settled. It was soon found that Celestial diplomacy could hold its own against that of the West, but it was felt to be intolerable that all the advantages of a rapid means of communication should be on the side of the barbarian. The telegraph-wire, at any rate, soared above the gods of the earth and the spirits of ancestors at rest within the tomb. It interfered with no man's property, and not even the most superstitious of the censors had a valid objection to offer. In fact, all that was required was a fair start; and, that once obtained, the wires "forged ahead" until in 1884 there were 3,089 miles of line open, and the imperial authorities at Peking found themselves in direct communication with the Marquis Tseng, who was then their representative in Great Britain.

This was a great step in advance, and quite in keeping with the Chinese method of reversing the procedure of other countries. For once, the telegraph had given a lead to the railway, and other influences were at work to hasten its lagging steps. The veteran warrior and statesman, Tso Tsung-t'ang, lay sick at Foochow. He had seen the masterly subjugation of the rebels in Kashgaria during the long years between 1871 and 1877, where also his own victories had won for him a place in Chinese history beside the most famous generals of old. The Taiping rebellion had received its death-blow at Gordon's hand, but the constant fear of Russian encroachments on the Mongolian frontier, the extreme delicacy and even danger of China's relations with Japan, the restlessness of

Corea under the imperial suzerainty, and the impending difficulties with France, filled his patriotic soul with trouble. It may be that with the prescience begotten by approaching death he foresaw the parlous times in store for his country, when France should reach her frontier on the south, when Great Britain should touch her borders on the west, and Russia should approach as near on the north. He was passing away, and on whom was his mantle to fall? His own difficulties in grappling with an internal war had been heavy enough, but who could save China in the future, when her enemies hemmed her in on every side? In a most touching memorial to the throne, penned shortly before his death, he reviewed the situation, and, with all the weight of his tried patriotism and experience, urged the construction of railways as a first means of safety for his country. The appeal could not pass unheeded by either his countrymen or the government. The effect on public opinion of such an utterance from one of China's noblest and most trusted sons, with all the weight lent by his subsequent decease, was indeed enormous. It soon became known that the Viceroy of Chihli, and his *protégé* the Viceroy of Formosa, were in favor of the project. In 1887 the Marquis Tseng returned from his duties abroad to take up an important position in the capital, and to throw all his additional knowledge and experience on the side of reform. The same year an historical event happened which had an important bearing on the case. For the first time a prince of the royal blood visited a foreign settlement. Prince Ch'un, who is the father of the present emperor, and a man of liberal views, journeyed as far south as Chefoo to inspect the Chinese fleet. For the first time in his life he came in contact with foreigners, and was able to see for himself the value of modern inventions. On his return to Peking, he laid the results of his journey before the dowager empress, and it soon became known that this wise and astute lady was also on the side of progress. The body of censors, who there perform the functions of a parliamentary opposition with England, were ominously silent,—a sure sign of their consciousness that any protests of theirs would be ill received at court. In a word, the times seemed ripe, and, after one or two preliminary memorials, the imperial rescript was issued in March of last year, and the die was cast. For the first time official sanction was obtained for the novel undertaking, and nothing remained but to put it into execution. The matter was happily intrusted to Li Hung-chang, by far the most enlightened and able statesman in China, and in his hands it was felt that success was assured.

But he had set himself a difficult task. To allay the hostility and smooth the susceptibilities of a conservative and superstitious people demanded all the care and tact at his command. The slightest mistake might mean failure, and to insure success the greatest caution was necessary. His first step was to familiarize the people gradually with the new means of locomotion. The year before the rescript was granted, a small railway on the Decauville system was laid at Tientsin, and for a few cents the public were whirled round a circle of two or three miles. The snorting little engine was found, on acquaintance, to be not such a very dreadful object, after all, and for several months curious and delighted crowds thronged the carriages. Meanwhile, Liu Ming-ch'uan had not been idle in Formosa, and a line of strategic railway was being constructed in the very country where a few years before the old Wusung rails had been thrown down in contempt. The third and most important step, however, was made in Li Hung-chang's own province of Chihli. Tong King-sing, a man of great ability and with a taste for Western inventions, had opened at Tongshan the first colliery in China worked on foreign principles. The engineer-in-chief was Mr. C. W. Kinder, a man thoroughly honest, able, and reliable. Under his management, a railway had been constructed to convey the coal from the mine to the port of shipment, some twenty miles distant, and at this the authorities had been content to wink. Here, then, was a man ready to hand, and to him accordingly Li Hung-chang applied. The China Railway Company was formed, with Chinese directors indeed, but with European engineers, and work was at once commenced. "*T'ieh lu lai la*" ("The railways are coming"), said Prince Kung once to Dr. Wells Williams at Peking. A decade and more has passed since then, and at last the prince sees his prophecy fulfilled.

The Tongshan line has now been extended until a distance of 81

miles has been completed: viz., Tientsin to Tongku, 27 miles; Tongku to Lutai, 25 miles; and Lutai to Tongshan, 29 miles. In addition, there are 5 miles of sidings and branches. The line is a single one, the rails are of steel, and the gauge throughout is the 4 feet 8½ inches common in Great Britain. The four passenger and seven tank locomotives were, with one exception, imported from England.

Financially there is every reason for believing that the new railway will be a success. The small Tongshan line has already paid a dividend of 6 per cent, and the extension will add enormously to its profits, tapping as it does a populous stretch of country and a busy centre of commerce like Tientsin. An additional feature is the extreme cheapness with which the line has been constructed. The country through which it passes is flat and marshy, and in certain seasons of the year liable to inundations. In consequence of this, an embankment of 8 feet in altitude was in some places required, some fifty bridges had to be constructed, and an extensive system of water-channels was found necessary. Bearing this in mind, the total cost so far — viz., a million and a half of taels, or, say, under £4,300, per mile — is exceedingly small, and reflects the greatest credit on Mr. Kinder and his staff.

A comparison between the Japanese and the Chinese is a favorite theme with travellers, who never tire of contrasting the former's rapid strides with China's timid steps along the path of progress. No doubt Japan is far ahead of China in all modern improvements, but her pioneering has been expensive work, and China has profited by her experience. The first railway in Japan, from Tokio to Yokohama, a distance of 18 miles, was completed in 1880, at a cost of £34,263 per mile. The difference in cost of the two railways is certainly remarkable, but the detailed items of expenditure are not sufficiently numerous to enable one to form an accurate comparison. The engineering difficulties of the Japan line were apparently no greater than in China, and the gauge was only 3 feet 6 inches, as opposed to the 4 feet 8½ inches of China. On the other hand, the line was a double one; but, after every allowance is made, it seems evident that the Japanese were heavily fleeced in their first railway contracts, and that the Chinese have profited by the experience of their neighbors.

In the numerous troubles and even riots that arose as the railway pushed its way past mouldering graves and through the well-tilled fields, the viceroy found an able ally in Wu Ting-fang, a man of great tact and energy. Combining the *suaviter in modo* with the *fortiter in re*, he managed with success to conciliate the prejudices of the small farmers, the bones of whose ancestors he was about to disturb. Wu Ting-fang spent some years in England, and qualified himself with honors as an English barrister-at-law. The management of the railway is now virtually in his hands, and his foreign experience should stand him in good stead.

At the end of September the new line was opened for traffic, and trains are now running daily over the whole distance. Tickets have been printed, a time-table published in the *Chinese Times*, and crowds of natives are already availing themselves of the novel mode of conveyance. The engine-drivers are as yet Europeans; but the Chinese have shown a remarkable aptitude for work of this kind, and may soon be expected to replace their foreign competitors.

On the 9th of October, Li Hung-chang made his first journey of inspection. He was received at the Tientsin station by the foreign engineers and by an imposing array of Chinese officials clad in their robes of state. A body of foreign-drilled troops was stationed for some distance along the line, and, by their smart appearance and soldierly bearing, formed a striking contrast to the native braves, armed with ancient gingals and bows, and dressed in tawdry uniforms of black and yellow. The viceroy entered the handsome saloon carriage built for him, and, amidst a *feu de joie* from the soldiers, steamed out of the station at 8 A.M. The carriage is provided with a bedroom, a lavatory, and rooms for the viceroy's suite. The teak furniture was supplied by a firm of upholsterers at Shanghai, and the general decorations are tasteful and handsome. The viceroy showed a lively interest in the new work, and, to facilitate his inspection, the train proceeded slowly; but during one part of the journey he was bowled along at the rate of fifty

miles an hour, and this speed could easily have been increased. After a short rest at Tongshan, his Excellency returned to Tientsin, much pleased with the result of his visit. It would have been extremely unfortunate had any thing occurred to excite Chinese fears or prejudices, but happily the trial passed off without a hitch. A formal report has been ordered to be submitted to the Throne and to Prince Ch'un. Its tenor will undoubtedly be entirely favorable, and the railway system will receive its *imprimatur* immediately.

The first railway in China — the Wusung affair was merely an experiment — has thus been brought to a triumphant conclusion. With the record of previous failure before us, we must guard against being too sanguine, but for this railway there is no need to fear such a catastrophe as that of Wusung. It is not a foreign, but a Chinese undertaking, with native directors, who will be shrewd enough to protect their own interests; and obviously it rests on a sounder basis. Its slow growth affords the surer hope of its stability, and it needs no prophet to foretell that once more China is entering on a new era of civilization. Still, it is believed, the growth will be slow, and until the capital is reached it is unlikely that any comprehensive scheme will be adopted. China has as yet only tasted the advantages of Western civilization, but the morsel has been large enough to excite her appetite for more. If Taku were again threatened, troops could now be poured in by the railway, and the capture of the forts would be a more serious matter than it was in 1860-61. But Taku is not the only vulnerable point, and the railway must be extended to Shanhai-kuan, which lies some eighty miles in an opposite direction, before the defences of the capital can be considered complete. It is practically settled already, however, that the first extension shall be some seventy miles north to T'ung-chou, an old port on the Peiho, fifteen miles from Peking. The provincial officials who are continually travelling to and from the capital on business, and the crowd of undergraduates who go there to be examined, can now sail from the south to Taku in a comfortable foreign steamer. As soon as the extension is completed, they will be able to traverse the distance between Taku and T'ung-chou with an ease and rapidity in striking contrast to the painful and tardy journey by cart to which they have hitherto been accustomed. At T'ung-chou they will be forced to disembark, and endure the torture of driving in a Peking cart over the thirteen miles of stone road by which Marco Polo travelled more than six hundred years ago. No one who has not made that journey can realize what it is to be cooped up in a springless cart, like an enlarged dog-kennel placed on wheels, and to be bumped and jolted over these blocks of masonry, one wheel now high in the air, rattling the unfortunate traveller's head against one side of the cart, and anon sinking deep in a bog, to send him flying with a lurch to the other, until, bruised and bewildered, he sees the gates of Peking loom in sight, and, with a sigh of relief, endures a final jolt as he passes under the ponderous archway. That journey will be the motor muscle of railway extension. Human nature, even Chinese human nature, will not long endure the anomaly of spending three hours of peace and comfort over the first 130 miles of a journey, and three hours of pain and torture in covering the last 13 miles. The discomfort of it is a blessing in disguise; and when the Peking station is opened, and the railway-whistle shrieks as we near its ancient walls, we shall draw our rug closer about us, and bless the old road for what it has brought. Once the exclusion of the capital is broken down, who can predict what will follow? The growth, as has been said, will be slow, and it is well that it should be so. No grand trunk lines will be attempted until repeated small extensions have been proved a success. That success may be considered assured, but the Chinese are right to prove it for themselves. And as the years roll on, we may conclude that first one province and then another will fall under the sway of the Iron King, until an arterial system of railways shall bear new life and vigor to every extremity of corporate China, and she wakes once more to feel her old strength, but with it a new potentiality for the safety and peace of her people.

With regard to the results which will spring from the introduction of railways in China, we may find a fair parallel in the benefits which have accrued to India since they were established there. Agriculture will receive a much-needed impetus, rebellions will be

made impossible, the food of the common people will be cheapened, their luxuries increased, their standard of comfort raised, and the famine demon will depart, never to return. Wider and more general information will be diffused throughout the empire, and, with enlarged knowledge and sympathy, the old-time ignorance and exclusiveness will disappear. But with the peculiar conditions of Chinese civilization, reforms more interesting and unique than these will certainly follow.

From the difficulty and expense of travel, the inhabitants of the various provinces have been born and brought up in a state of seclusion devoid of modern experience. A Chinaman is, as a rule, born and buried within a radius of a few miles. Practically he is a stranger to his neighbor, and an astonishing variety of language is the result. In all, there are nearly 300 dialects spoken in China, many of which are as different as French and English. It is not uncommon to see a southern Chinaman meet a countryman from the north, each utterly unable to comprehend the speech of the other. The facilitation of travel must, in course of time, do much to mitigate this babel of tongues, and the necessities of the case must produce some modification of one of the principal dialects, from which a new universal language for China will be evolved. This hope seems the more reasonable, as the written language is the same all over China. There is also a fainter hope of a reform in the written language itself; and perhaps a later generation may know the blessings of an alphabet, and exchange the present cumbrous and involved ideographs for a system of phonetic romanization.

Railways will also produce an entire reform in the Chinese currency. The same reasons which have produced a variety of languages have also conserved the most bewildering varieties of weights and measures. There are no coins of any kind, with the exception of small brass and iron *cash*, of which from ten to twenty, or even more, are equal to a penny. For all large payments, lumps of silver are employed, which are generally, for convenience' sake, moulded into the form of a shoe. In making a purchase, you produce your silver, and, after one lengthened dispute as to its quality, you enter upon discussion number two as to the particular measure of weight to be employed, of which there may be several. In Peking, for instance, there are no less than five in common use. All this, of course, occupies much time, and it would be manifestly impossible for the train to wait while a bevy of passengers were conducting the purchase of their tickets in this way. A coinage will have to be adopted. The standard chosen will probably be a coin of silver, of one tael in weight, and equal to about \$1.08 of our money, and the smaller coins will be in decimal proportion. The convenience to the country and benefit to commerce of the new currency will be felt from one end of China to the other.

It will be necessary also to adopt a foreign standard of time. At the treaty ports there is a ready sale for cheap clocks and watches, and the Chinese who have dealings with foreigners have not been slow to appreciate their convenience. In Peking there is a considerable number of watchmakers, descendants of old Catholic families, who still practise the somewhat antiquated horology which their fathers learned from the early Jesuit missionaries. But the system in vogue throughout China remains unchanged from the days of antiquity. The entire day is divided into twelve periods of two hours each, beginning at 11 P.M. Each period is known by the name of some animal, and is further divided into eight *chih*s, corresponding to our quarters of an hour. The nights are, in addition, divided into five watches, which the patrols ring out from wooden drums; but there is no smaller subdivision than the *chih*. For time-keepers they have sun-dials, or clepsydras, or spiral incense-sticks, arranged, like King Alfred's hour-candles, to burn for a certain length of time. If you ask the time of day, you will be told that it is near the dog, or two-eighths from the rat; but more approximately than that, you cannot get. It is curious that a people so industrious as the Chinese, and so studiously economical in their habits, should never have a juster estimate of the value of time. To them, so far from time being money, money is every thing, and time nothing. He who aims at being the *superior man*, whom Confucius held up as a model for all time, must never be in a hurry. Every thing must be done in a dignified and de-

liberate manner, and the idea of a quarter of an hour, more or less, making the slightest difference to himself or any one else, has not yet entered the Celestial cranium. It will be one of the greatest surprises in the life of a mandarin when he first stalks down to the railway-station, and finds that the train is timed to start to the minute, and will wait for no man. Happily, there can be no objection, superstitious or otherwise, to the introduction of timepieces, and the railway clock will be the precursor of a new punctuality and despatch in China.

Changes so far-reaching and profound as these cannot fail to produce a sensible modification of the Chinese character. The odium and contempt in which foreigners are held, simply because they are foreigners, will melt away as opportunities for intercourse increase.

As yet the question has been considered only from the Chinese point of view. The interesting point is that the new railway sounds the death-knell of Chinese exclusiveness. The empire can no longer remain sealed, and now is the time for England to consider if she is in the best position for taking advantage of the vast field of commerce which may shortly be thrown open. English consuls have recently borne a singularly unanimous testimony to the apathy of the British trader, and he must be on the *qui vive* now if he does not wish to see the benefits of the coming change pass into the hands of others. To begin with, the Chinese are totally unacquainted with modern engineering, and the railway construction of the immediate future must be done for them by foreigners. Both with engineers and traders, a serious difficulty will be the want of men familiar with the Chinese language and mode of thought. For several years past, the professor of Chinese at King's College has labored, with a zeal and enthusiasm which deserved a better return, to supply this want. To meet the convenience of clerks and others unable to attend during the day, a series of evening classes was started, of which the first-fruits may be seen in the successful career of some of Mr. Douglas's old students in China. But these may be counted upon the fingers of one hand, and the general result must be pronounced disappointing. Probably no attempt by an English professor to teach an Oriental language without the aid of a native assistant is likely to be completely successful. But this is a desideratum which could and should be easily supplied. A greater, and alas! almost insuperable difficulty remains in the apathy and indifference of those in whom indifference is least excusable. Foreign clerks employed in England arrive with a general knowledge of two or more languages, while your Englishman is accustomed to hold in contempt all languages except his own, and even to feel a certain pride in his ignorance. His neighbors are more quick-witted. Men are drafted off to China from the Oriental College at Paris, who, on their arrival, exhibit a very passable acquaintance with the rudiments of the Chinese language. A similar college has just been opened at Berlin; and the chair of Chinese is filled by Professor Arendt, a sinologue of the highest standing. True, England has professors of Chinese at her universities, but the teaching given is too scientific to be of much use to commercial men. Business men have neither the time nor the inclination to form even a tolerable acquaintance with Chinese literature or the flowers of official discourse. It must not be forgotten that the written language, the language spoken among officials, and the ordinary colloquial, are practically three different tongues. It is the last which is necessary, and happily the colloquial is well within the reach of any one who cares to approach it in a spirit of patience and perseverance. With a Chinese teacher, under the supervision of a European sinologue, a two-years' course would be sufficient to equip any one of ordinary ability and application with a fair talking knowledge of the colloquial, which would prove of immense service to him in China. The importance of such a course on the future commercial relations of England with China is sufficiently apparent. The danger lies in delay. The former has now a strong hold on the foreign trade of China; but, when the interior is thrown open, there will be an enormous development in every branch of commerce. Foreign banks and trading-houses will become as much a feature of the inland as of the seaboard towns, and the English will have to strain every nerve to maintain their old lead, or the French and the Germans will be before them in the race.

SCIENCE-TEACHING IN ENGLAND.

MR. J. H. GLADSTONE, in an article in *Nature* of May 2, on the new code of the Education Department,¹ which was then before the House of Commons, says that never, since the famous proposals of Mr. Mundella, has there been so much stir among those interested in primary instruction as at the present moment. The reason is not far to seek. For some years a royal commission has been sitting and taking evidence, and it has produced several bulky Blue Books during the course of the past year. It was known that the commission was divided into a majority and minority who were strongly opposed to one another on certain questions of policy. This has found expression in lengthy reports and contradictory recommendations; but, to the satisfaction, if not to the surprise, of educationists, it is found that on purely educational matters there is an almost perfect unanimity between the two sections. It was therefore a matter of deep interest to see how, and to what extent, these recommendations, signed by every member of the commission, would be embodied in the proposed code of 1889.

There are several alterations in this code which are almost universally allowed to be improvements; but it is conceived in a spirit of compromise, and perhaps no party is entirely satisfied with it. The only point to be considered is the aspect of the code towards the teaching of natural science. It may be convenient to group Mr. Gladstone's observations under different headings.

I. The direct changes proposed in the teaching of science. These are almost confined to one or two modifications in the geographical schedule, and to a provision that "scholars of any public elementary school may attend science classes held at any place approved by the inspectors." This may be very useful in towns, especially as it will admit of the formation of central laboratories or workrooms similar to the present cookery centres.

II. The proposed changes which will tend to facilitate the teaching of science. There are four subjects of instruction which are termed "class-subjects," — English (including grammar, composition, and repetition of poetry), geography, elementary science (a progressive course of object-lessons), and history, — together with needle-work for girls. Only two of these class-subjects can be taken for examination, and, under the old code, English must necessarily be one of those chosen. The consequence of this is, that elementary science has never got a footing in the schools in England; for, even where two class-subjects are taken, they are nearly always English and geography, or English and needle-work. The supremacy of English is now to be put an end to, so that any teacher may now take elementary science, if he or she should prefer it, and earn a grant.

The enormous waste of time and patience in making little children, even in infant-schools, learn the spelling of common words, is to be reduced. The inspector is to give no dictation exercises to boys and girls under the second standard. This will give more time for object-lessons and other valuable modes of instruction. Some relaxation of the literary requirements are also made in the case of evening-schools.

The present system of payment by results is to be so modified that the cramming in the three R's will not be so profitable, and there will be more chance for intelligent teaching. One of the matters also to be taken into account by the inspector, in assessing a school, is the provision of apparatus, though this need not necessarily have any thing to do with what scientific men would call by that name.

These proposed changes are in the right direction, but the value of many of them will largely depend upon how they are understood. There is a singular want of clearness in some of the clauses. The annual instructions to inspectors have not yet been drawn up, and indeed it is very improbable that they will make their appearance until after the code has become law. It is quite possible to take away with one hand what is given with the other. The present agitation is therefore of great importance not merely in getting modifications of the code when discussed in Parliament, but in inducing the Education Department to give their inspectors such instructions as shall secure that the greater liberty of teaching

should be a reality; that the ominous word "repetition," introduced into one or two paragraphs, may not become "English" in disguise; and that the spelling of the second standard should not involve a laborious preparation of the younger children.

III. These alterations bearing on the teaching of science fall far short of what the royal commissioners unanimously recommend. The report of the majority states that "some elementary instruction in science is only second in importance to the three elementary subjects," — namely, reading, writing, and arithmetic, — and it places among subjects regarded as essential, "geography (especially of the British Empire); lessons on common objects in the lower standards leading up to a knowledge of elementary science in the higher standards." It adds, "that geography, if properly taught, is a branch of elementary science, which should not be separated from the other branches, and might well be taught along with the object-lessons, in accordance with the recommendations of the Royal Commission on Technical Instruction; that the curriculum in the ordinary elementary schools might often include not only instruction in the elementary principles of science, but also, in certain standards, elementary manual instruction in the use of tools, and in higher schools and evening-schools this work might be carried still further; that, in making future appointments to the office of inspector, it would be desirable, in regard to a larger proportion of them than at present, to give special weight to the possession of an adequate knowledge of natural science." The members of the minority express themselves, if possible, more strongly, and make such additional remarks as, "We are of opinion, that, after the children have left the infant-school, transitional methods should be adopted, which will develop their activity and train their powers by drawing in all cases, and by such other means as, for instance, modelling, or the collection and mounting of botanical specimens. . . . If science is to be well taught, care should be taken, that, where the ordinary teachers are not qualified, specially trained teachers should be employed." In respect to technical schools they say, "These schools, which should be the crown and development of elementary education, should be in touch and close sympathy through their management with our elementary school system."

IV. The proposals of the new code also fall far short of what the principal school boards are attempting. Spirited efforts are made in Birmingham, Manchester, Sheffield, Brighton, and other provincial towns, in establishing higher elementary schools with useful scientific teaching. The London Board determined from the commencement that object-lessons leading up to science subjects should be given in all its schools. It has repeatedly contended for the official recognition of such lessons; and it has lately sent a memorial to the Education Department, asking that the regulation at present in force in the infant-schools, that, in assessing the grant, regard should be had "to the provision made for simple lessons on objects and on the phenomena of nature and of common life," should be extended to the boys' and girls' departments.

The reforms decided upon by the London Board last year, with the view of making the teaching more experimental and practical, and not so much a matter of book-learning as a development of intelligence and skill, are being gradually put into operation.

It has also for some years carried on a few classes for manual instruction in the use of tools with good success, but its efforts in that direction have been nearly paralyzed by the disfavor of the legislature. This seems a necessary step towards the technical education which is now loudly called for; but in the new code we look in vain for a word of encouragement.

Some of the larger boards have carefully provided good instruction in natural history, and in the fundamental principles underlying mechanical, physical, and chemical science, for their pupil teachers, though that does not appear upon the government schedule.

V. What is wanted is a far more liberal recognition of the claims of science in elementary education. At present, object-lessons or certain sciences are, no doubt, recognized by the code; but it is merely as an additional subject of instruction not comparable with the literary subjects which are considered essential, and which occupy the great bulk of the scholars' time. The knowledge of nature is, in fact, totally neglected in hundreds or thousands of

¹ Code of Regulations, with Schedules, by the Right Honorable the Lords of the Privy Council on Education (London, Eyre & Spottiswoode).

elementary schools, especially in country districts, where it would appear to be even more important than in towns. A boys' or girls' school can obtain the highest credit in the inspector's report, and the highest possible grant of money, without its scholars having ever heard of animal or plant, or of those materials of the world, or of those natural forces, with which the scholars will have to deal all through their lives; and, what is perhaps still more anomalous, those pupil-teachers who are possibly expected to give object-lessons in their schools are never examined in natural history by the department, and may gain a high place in their examinations without the least knowledge of any kind of natural science.

It seems most desirable that every little child who enters school should be led to observe and inquire; its curiosity and activity should be encouraged and directed; only when its senses have been made acquainted with things should it be introduced to the words by which they are called, first orally, then in writing or print. It should proceed from the concrete to the abstract. The works of the Creator are as worthy to be studied as the words of men, and should hold as high a place in any school curriculum.

The reply of the department to such requests as these will probably be, "We cannot assume that the teachers are capable of teaching, or the inspectors of examining science." No doubt there is that difficulty. But many of them are capable, and they are all presumably intelligent men, who would easily learn what might be required of them. Special teachers of science also exist, and special examiners might be appointed. It may not be possible to insist on all these reforms at once, but at least encouragement should be held out to them, instead of the disappointing uncertainties of the code now before Parliament.

HEALTH MATTERS.

Tuberculosis Contagion.

DR. VON DUHRING reports to the *British Medical Journal* a case of tuberculosis which was contracted by wearing a pair of earrings. The patient, a girl of fourteen years, removed the earrings from the ear of a young girl who died of consumption, and wore them in her own ears. Soon after, an ulcer formed in the left ear, the discharge from which, when examined, was found to contain tubercle bacilli, and a gland in the neck also enlarged and ulcerated. The patient developed pulmonary consumption, and at the date of the report was sinking rapidly.

This case is one of great interest as showing another channel by which the bacilli of tuberculosis may enter the system. The inquiry will naturally suggest itself, whether this patient was not already phthisical at the time she began to wear the earrings, and the development of the disease at that time a mere coincidence. This would seem the more probable from the age of the patient, which was fourteen years. Then, too, the report states that these two girls were intimate friends, so that the seed may have been sown during their lifetime. Some years ago either of these explanations would, to most minds, have been sufficient; but, through the researches of Koch, an additional means of determining the question has been made available. This is the detection of the bacilli themselves. The report states that this was done in the case mentioned; and, as the methods are simple and decisive, there is no reason to doubt the accuracy of the report. The enlargement of the gland in the neck is additional evidence that the earrings were the source of the infection. It would be interesting to know whether the ears of the first patient were ulcerated or not.

ELECTRICAL NEWS.

ELECTRICAL COURSE AT COLUMBIA COLLEGE.—In view of the prodigious strides which electricity is now making, it is but natural that the necessity for the establishment of a means whereby its thorough and systematic study can be undertaken should have engaged the attention of educational bodies in this country. Columbia College, which has always occupied a prominent position in science, has now established a course of electrical engineering. As its professors, it has secured the services of two men of

excellent repute in electrical and mathematical circles. Mr. Francis B. Crocker, who assumes the instructorship, is no stranger to many of our readers. As one of the inventors of the C. & C. motor, his name has for some time been conspicuously before the public; and his papers read before the American Institute of Electrical Engineers (among which may be specially mentioned that on "Chemical Generators of Electricity," last year) and other scientific bodies have never failed to meet with a welcome. Mr. Crocker is regarded as a rising man in electrical circles; and in this view it is significant that he was, a few weeks ago, elected to the presidency of the New York Electrical Society, which is the oldest organization of its kind in the country. Mr. Michael Pupin is the assistant instructor. From Mr. Pupin's past work and present reputation, great things are expected of him, and he brings to his new sphere of action the additional prestige of having studied under Helmholtz in Berlin.

NOTES AND NEWS.

DURING the past year the director of the Michigan Weather Service has had compiled the average monthly rainfall for each section of that State, and has had the figures published in the monthly report. Believing that the information thus compiled could be better shown by being charted, the director made a chart of the State, showing the average monthly rainfall for each month and for the year. These charts were made up from the observations of thirteen years, and about four thousand reports were examined and proved, to obtain the data. There were also made the charts of the monthly and annual rainfall for the past year which are to accompany the normal charts. These charts will be of great value to the people of Michigan, as the rainfall can be readily compared with the normal, and thus ascertain in each locality whether the rainfall has been the average or not.

— Professor Rosenthal of Erlangen, at a meeting of the Berlin Physiological Society, March 27, gave an account of calorimetric experiments with which he had been busied for the last few years. He employed in these, says *Nature*, an air-calorimeter of special construction. It consisted of a copper vessel, of easy ventilation, in which the animal was placed; this was surrounded by an airtight envelope, filled with air and constituting the reservoir of an air-thermometer; external to this was a covering to shield the whole apparatus from any changes in the temperature of the surrounding atmosphere. When the animal gives up to the envelope of air, per unit of time, exactly the same amount of heat as the whole apparatus radiates into the surroundings, the temperature of the air in the envelope remains constant, as also its pressure: hence the heat produced and given off by the animal during any known time could be measured by means of a manometer. Notwithstanding that the dog used in the experiments was fed in exactly the same way at each meal, the quantities of heat produced varied very largely, and any considerable uniformity is only obtained by taking the mean of a long series of observations. Up to about the third hour after the meal, the heat-production diminishes, then rises rapidly to a maximum; and from this point, at about the eighth hour, it begins to fall again slowly, and with irregularities, until the next meal. Over the whole twenty-four hours the heat-production is more uniform during the second period of twelve hours than in the first; about 20 per cent more heat is produced during the first than during the second half of the whole day. When an excess of food was given, the heat produced was always less than that calculated out from the oxidation of the food itself; but, with a uniformly constant diet, the mean value of the heat produced corresponded to the heat calculated for the oxidation of the food. The amount of carbonic-acid gas given off by the animal was found to correspond to the heat given off during the same period only in cases where prolonged intervals of time were taken into account. When the surrounding temperature varied between 5° and 25° C., all other conditions remaining the same, a minimum production of heat was observed at 15° C.: from this point it increased uniformly in both directions, not only when the temperature fell to 5° C., but also when it rose to 25° C. Professor Schweigger demonstrated several pieces of apparatus, which, by the use of small incandescent electric lamps, could take the place of the ophthalmoscope, and even

render a binocular examination possible. They also made the measurement of refraction in the eye both simple and exact.

— We learn from *Nature* that the extraordinary meeting of the Société Géologique de France, which will be held this year in Paris, beginning on Aug. 18, promises to be one of great interest. During the week devoted to the meeting, the collections in Paris will be visited, and there will be a series of excursions to places of interest within easy reach of that city. In the week following the meeting, excursions will be made to more distant localities; among others to the Auvergne and Brittany, — that to the former district under the guidance of M. Michel-Lévy, and that to Brittany conducted by M. C. Barrois. Arrangements will be made with the railway authorities for a reduction of fifty per cent upon the fares; but, in order to secure this advantage, the names of persons intending to attend must be sent to the secretaries of the society before July 1. British geologists, and especially fellows of the Geological Society of London, are cordially invited to be present.

— Professor W. A. Henry, writing in *Agricultural Science* of some weeds that are becoming troublesome in Wisconsin, says, "On the great plateau along the eastern flank of the Rocky Mountains grows *Solanum rostratum*, a homely, harmless sort of plant. The naturalist knows it to be the original food-plant of the Colorado potato-beetle (*Doryphora 10-lineata*). In the year 1872 or thereabouts the beetle, coming across the uncultivated strip of eastern Colorado and western Kansas, found a new food-plant in the common cultivated potato, and spread with marvellous rapidity over the country. *Solanum rostratum* also comes into the fields to conquer, and has spread on cultivated lands in Texas and Missouri, where, with greatly increased size, it proves a troublesome weed. Last summer Mr. L. H. Pammel, one of our agricultural graduates, now professor of botany in Iowa Agricultural College, found this plant growing at Watertown, in this State. It is following up the potato beetle. Will it spread over as large an area as its old acquaintance?"

— The annual congress of the German Pomological Society will be held this year at Stuttgart, between the 22d and the 30th of September.

— In 1887 a spot-disease was observed on cucumbers near Geneva, N.Y., which almost ruined the crop. Professor Arthur, says *Garden and Forest*, pronounces it a parasitic fungus similar to one which has been disfiguring peaches in Indiana, detracting from their beauty and hindering their growth. The cucumber-spot did not appear at Geneva in 1888, although it seems an aggressive fungus. It has been named *Cladospodium cucumerium*. The fungus on peaches has only been recorded before as occurring in southern Austria, where it was named *C. carpophilum*. No remedies for either disease have yet been tried so far as known, but both of them threaten to become dangerous pests.

— A writer in the London *St. James Gazette* objects strongly to the use of footnotes in books, and particularly criticises Mr. Bryce's recent work on this account. He says, "Except for the purpose of relieving the text of references, the footnote has no proper place in any book that deserves to be called a book. It is at best a kind of purgatorio, to which an author consigns such remarks as he thinks unworthy of admitting to full honors, and yet has not the courage to cast out altogether. But there is hardly a page of Mr. Bryce's book without footnotes, and hardly a footnote which might not well have been incorporated in the text. Often, indeed, the footnote contains the very 'plum' of the page."

— According to a report lately issued by the Russian Department of Indirect Taxation, there were, in 1887, 2,775 distilleries in Russia, chiefly engaged in producing spirits from fruit. Compared with the preceding year, the number of these distilleries increased by 483; that is, about 21 per cent. This branch of industry is principally concentrated in the Caucasus, where it is rapidly becoming extended. The province of Elizabethpol takes the first place with 1,265 distilleries, then follows Tiflis with 491, Baku with 465, Erivan with 218, and the territories of Koutais and Daghestan with 108. Among the 2,775 distilleries in question, the industrial establishments, properly so called, amount to the number of 260. The product of the distilleries amounted in 1887 to

39,924,903 degrees of alcohol, which yielded to the treasury a sum of 924,805 roubles in excise and other duties.

— By order of the French minister of public instruction, the International Congress of Elementary Education will be held at Paris from Aug. 11 to Aug. 18, on the occasion of the Universal Exhibition. The following are the chief questions for discussion: 1. Under what form and to what extent can professional (agricultural, industrial, commercial) instruction be given in the elementary schools of the lower and higher grades and in training-colleges? 2. How far should women be employed in elementary education as teachers, heads of schools, and inspectresses? 3. What are the functions and the organizations of the practising schools attached to training-colleges and institutions of a like character?

— The students of the ancient University of Genoa, says *The Educational Times*, must be singularly unlike "our young barbarians all at play" on the banks of the Isis and Cam. The Italian students actually desire a competent professor of mathematics, vigorously protest against the fitness of the existing professor, and in general meeting assembled came to the conclusion of demanding by telegraph from the minister of education the appointment of a new professor. In our ancient universities, the honor students find it a serious waste of time to attend college lectures, and so they desert the lecture-hall for the rooms of their private tutor. The ordinary pass student is also quite indifferent as to the quality of his lectures. He also, like the honor student, seeks the aid of the private "coach" to pull him through his examinations. To think of them in open meeting discussing the proper filling of a professorial chair is simply impossible. The Genoese students are of a very different temper. The education minister taking no notice of their singular demand, the whole body of students joined the mathematical men in a general strike, and declined to attend any lectures. Thus the university is closed until this odd dispute is composed.

— In 1887 the population of Bulgaria amounted to 3,154,375, or 31 inhabitants to the square kilometre. The population of the principal communes was distributed as follows: Philippopolis, 33,412; Sofia, 30,428; Rustchuk, 27,198; Varna, 25,256; Shumla, 23,161; Slivno, 20,893; Zagora, 16,039; Tatar Bazardjik, 15,659; Vidine, 14,772; Plevna, 14,307; Sistov, 12,482; Silistria, 11,414; Tirnova, 11,314; and Kustendjs, 10,689 inhabitants. As regards nationalities, the population of 1887 was composed as follows: Bulgarians, 2,326,250; Russians, 1,069; Servians, 2,142; Turks, 607,319; Greeks, 58,338; Jews, 23,546; Gypsies, 60,291; Germans, 2,245; French, 544; and 80,074 persons belonging to other nationalities.

— The University of Munich has been celebrating the ninety-ninth birthday of its famous professor, Dr. Ignatius Döllinger. For sixty-three years Dr. Döllinger has filled the chairs of ecclesiastical history and canon law. As a politician in the Bavarian parliament, and as leader of the Catholic party in the German parliament at Frankfort, he has played a conspicuous part.

— Floating exhibitions seem to have taken, at least so far as Germany is concerned. The German Export Company has decided, says *London Engineering*, to apply the sum of £250,000 (5,000,000 marks) to the building, equipment, and working of a very large steamer, which is to serve as a floating exhibition. The vessel in question will be called "Kaiser Wilhelm," and the principal dimensions are as follows: length, 564 feet; breadth, 66 feet; depth, 46 feet; so the question is not of a small craft. The steamer is to have four engines, entirely independent of each other, and four propellers. She is to be fitted in exceptionally good style. The expenses for a two-years' tour are calculated at £157,000, while the takings for hire of room and profits on sale are expected to reach £363,000, leaving the very handsome profit of more than £200,000. The steamer will, according to the present arrangements, be ready to start in the spring of next year. A previous undertaking of a similar nature, the steamer "Gottorp," despatched from Hamburg, is understood to have given a satisfactory result. Not only are German goods being shown in many different parts of the world, but the staff accompanying the steamer has ample opportunities for studying in each place the various local and special requirements,

and to see to what extent and in what manner the different wants are being supplied, either by home or by other foreign makers.

—Several friends of the late Dr. F. A. Paley, the eminent classical scholar, have purchased his classical library, and presented it to Cavendish College, Cambridge, England.

—We have given a list of many of the congresses and conferences to be held during the Paris Exhibition; but recently an official circular has been issued, giving detailed particulars. Further information concerning these congresses can be obtained by applying to their respective presidents, whose names and addresses are given: accidents to workmen (Sept. 9–14), M. Linder, 38 Rue de Luxembourg, Paris; advanced teaching (Aug. 5–10), M. Gréard, The Sorbonne, Paris; aeronautics (July 31 to Aug. 3), M. Janssen, Observatoire de Meudon, Seine-et-Oise; agriculture (July 3–31), M. Méline, Palais Bourbon, Paris; alcoholism (July 29–31), M. Bergeron, 157 Boulevard Haussmann, Paris; applied mechanics (Sept. 16–21), M. Philips, 17 Rue des Marignan, Paris; architecture (June 19–22), M. Bailly, 19 Boulevard Bonne-Nouvelle, Paris; artistic proprietary rights (July 25–31), M. Meissonnier, 131 Boulevard Malesherbes, Paris; assistance publique (July 28 to Aug. 4), Dr. Roussel, 64 Rue des Mathurins, Paris; baking (June 28 to July 2), M. Cornet, 34 Rue de Rochechouart, Paris; bibliography of mathematical science (July 16–26), M. Poincaré, 63 Rue Claude Bernhard, Paris; care of the blind (Aug. 5–8), M. Marten, 56 Boulevard des Invalides, Paris; celestial photography (no date); cheap dwellings (June 26–28), M. Siegfried, 6 Rond-Point de Champs Elysées, Paris; chemistry (July 29 to Aug. 3); chronometry (Sept. 2–9), M. de Jonquières, 2 Avenue Bugeaud, Paris; colonies, M. Barbey, 22 Rue du Regard, Paris; commerce and industry (Sept. 22–28), M. Poirrier, 105 Rue Lafayette, Paris; co-operative stores (Sept. 8–12), M. Clavel, 2 Rue de Bourgogne; criminal anthropology (Aug. 10–17), M. Brouardel, Ecole de Médecine; dentistry (Sept. 1–7), Dr. David, 180 Boulevard St. Germain; dermatology and syphilography (Aug. 5–10), Dr. Hardy, 5 Boulevard Malesherbes, Paris; electricity (Aug. 24–31), M. Mascart, 176 Rue de l'Université, Paris; ethnography, M. Oppert, 2 Rue de Sfax, Paris; female work (no date); fire departments (Aug. 27 and 28), M. Wolff, 18 Avenue Bosquet, Paris; geography (Aug. 6–12), M. de Bizemont, 184 Boulevard St. Germain, Paris; homœopathy (Aug. 21–23), Dr. L. Simon, 5 Rue de la tour des Dames, Paris; horticulture (Aug. 16–21), M. Hardy, 4 Rue du Potager, Versailles; hydrology and climatology (Oct. 3–10), M. Renon, St. Maur, Seine; industrial proprietary rights (Aug. 3), M. Tesserene de Bort, 82 Avenue Marceau, Paris; legal medical science, Dr. Brouardel, Ecole de Médecine, Paris; literary societies (June 17–27), M. J. Simon, 10 Place de la Madeleine, Paris; marine work (Oct. 7), M. Bernard, 43 Avenue du Trocadero, Paris; mental medical science (Aug. 5–10), Dr. Falret, 114 Rue du Bac, Paris; meteorology (Sept. 19–25), M. Renon, Observatoire de St. Maur, Seine; methods of construction (Sept. 9–14), M. Eiffel, 60 Rue Prony, Paris; mines and metallurgy (Sept. 2–11), M. Castel, 144 Boulevard Raspail, Paris; money (Sept. 11–14), M. Magnin, The Bank, Paris; otology and laryngology (Sept. 16–21), Dr. Duplay, 2 Rue de Penthievre, Paris; participation in profits (July 16–19), M. Robert, 15 Rue de la Banque, Paris; peace, M. Passy, 8 Rue Labordère, Neuilly-sur-Seine; periods of rest from work, M. Léon Say, 21 Rue Fresnel, Paris; pigeon-training (July 31 to Aug. 3), M. Janssen, Observatoire de Meudon, Seine-et-Oise; photography (Aug. 6–17), M. Janssen, Observatoire de Meudon, Seine-et-Oise; physical exercises in education (June 15), M. J. Simon, 10 Place de la Madeleine, Paris; physiological psychology (Aug. 5–10), Dr. Charcot, 117 Boulevard St. Germain, Paris; popular traditions, M. Ploix, Quai Malaquais, Paris; prehistoric anthropology and archæology (Aug. 19–26), M. de Quatrefages, 36 Rue Geoffroy St. Hilaire, Paris; primary education (Aug. 11–19), M. Gréard, The Sorbonne, Paris; protection of monuments (June 24–29), M. C. Garnier, 60 Boulevard St. Germain, Paris; saving of life (June 12–15), M. Lisbonne, 3 Rue St. Vincent de Paul, Paris; state aid in emigration (no date); state intervention in labor contracts (July 1–4), M. Donnat, 11 Rue Chardin, Paris; state regulation of the price of food (July 5–10), M. F. Passy, 8 Rue Labordère, Neuilly-sur-Seine; statistics, M. Levasseur, 26 Rue Monsieur-le-Prince,

Paris; stenography (Aug. 4–11), M. Grosselin, Palais-Bourbon, Paris; share companies (Aug. 12–19), M. Larombière, 16 Rue d'Assas, Paris; technical commercial education (July 8–12), M. Gréard, The Sorbonne, Paris; therapeutics (Aug. 1–5), Dr. Moutard-Martin, 136 Boulevard Haussmann, Paris; unification of time, M. Faye, 95 Avenue des Champs Elysées, Paris; utilization of rivers (Sept. 22–27), M. Guillemain, 55 Rue Bellechasse, Paris; veterinary medicine (Sept. 19–24), M. Chauveau, 10 Rue Jules Janin, Paris; workmen's clubs (July 11–13); zoölogy (Aug. 5), M. Milne-Edwards, 57 Rue Cuvier, Paris.

—The "Report of the General Board of Studies at Cambridge" (England), while curtailing the demands of the special boards, estimates the additional expenditure imperatively required, either at once or within a very few years, at a high figure. Under the head of "Annual Expenditure" come (1) increase in the salaries of lecturers, demonstrators, and assistants, at the least £1,000; (2) new chairs or lectureships of ancient history, Roman law, English palæography, general jurisprudence, and physiology, for which £1,500 seems a very modest allowance; (3) superannuation pensions for teachers and lecturers, say £1,000. Besides this, a capital sum must shortly be raised of £45,000 for new buildings and plant. This is apportioned between anatomy and physiology (£15,000), geology (£7,500), history (£3,000), library (£3,000), Botanic Gardens (£2,200), and the purchase of the Perse School (£12,500). The last item has already been agreed to by the Senate, and it is hoped that the plans which have been prepared for buildings to be erected on the purchased site—an anatomical museum and physiological laboratory—will be passed before the long vacation. The Medical School at Cambridge has grown within a generation from a few scattered students, mostly Caius men, to over four hundred.

—The latest number of the "Johns Hopkins University Studies in Historical and Political Science" is a pamphlet on "English Culture in Virginia," by William P. Trent. It is really an account of the foundation of the University of Virginia, and especially of the labors undergone in obtaining the earliest professors, most of whom had to be brought over from England. The information given in the pamphlet is derived in the main from the letters of a man named Gilmer, who was sent to England by the university authorities to engage the professors. The work can hardly be said to have any but a local interest, and we confess to have found Gilmer's numerous letters rather dry reading. If the University of Virginia was like those of Oxford and Berlin, its early history would have more general importance; but, as it is, a hundred and forty pages about the hiring of a few professors is rather too much. However, the work will doubtless be interesting to Virginians, and especially to graduates of the university.

—A parliamentary return dealing with the subject of railway collisions during 1888 has recently been issued. It shows that during the past year accidents to trains and rolling stock in Great Britain had caused the death of 11 passengers and 7 servants, compared with 25 passengers and 8 servants the year before; and the injury to 594 passengers and 93 servants, compared with 538 passengers and 109 servants in 1887. There were 101 collisions reported, 53 of passenger-trains leaving the rails, 20 of trains running into stations and sidings at too high a speed, 131 cases of trains running over cattle, and 57 of trains running through gates at level crossings. There were six fires in trains, and three fires at stations. Besides the casualties named above, 96 passengers and 389 servants of companies were killed, and 814 passengers and 2,100 servants injured from other causes. Fifty-three persons were killed and 24 injured through passing over railways at level crossings; 295 trespassers, including suicides, were killed, and 114 injured; and 54 were killed and 84 injured who are not classified. The total was 905 persons killed (a decrease of 14 in number) and 3,826 injured (an increase of 236 compared with 1887). This total is still further increased to 977 killed and 8,807 injured by other accidents, such as those occurring by falling down steps, on and off platforms, from the kicks of horses, and other causes. During the year, 24 horses, 3 ponies, 47 beasts and cows, 73 sheep, 2 donkeys, 4 hounds, 1 goat, and 1 dog were run over and killed.

SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

PUBLISHED BY

N. D. C. HODGES,

47 LAFAYETTE PLACE, NEW YORK.

SUBSCRIPTIONS.—United States and Canada.....\$3.50 a year.

Great Britain and Europe..... 4.50 a year.

Science Club-rates for the United States and Canada (in one remittance):

1	subscription 1 year	\$ 3.50
2	" 1 year	6.00
3	" 1 year	8.00
4	" 1 year	10.00

Communications will be welcomed from any quarter. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

VOL. XIII.

NEW YORK, MAY 17, 1889.

No. 328.

CONTENTS:

AMATEUR PHOTOGRAPHY AND ITS POSSIBILITIES <i>Laura M. Marquand</i> 371	SOAPING GEYSERS..... 382
IMPROVEMENTS IN THE BENTLEY- KNIGHT ELECTRIC RAILWAY SYS- TEM..... 373	THE EAST GREENLANDERS..... 384
RAILWAYS IN CHINA..... 375	THIRD ANNUAL REPORT OF THE DAIRY COMMISSIONER OF NEW JERSEY..... 386
SCIENCE-TEACHING IN ENGLAND..... 378	GOULD'S ORNITHOLOGICAL WORKS... 387
HEALTH MATTERS. Tuberculosis Contagion..... 379	BOOK-REVIEWS. Hints for Teachers of Physiology.. 388 The Leading Facts of French His- tory..... 388
ELECTRICAL NEWS. Electrical Course at Columbia Col- lege..... 379	AMONG THE PUBLISHERS..... 389
NOTES AND NEWS..... 379	LETTERS TO THE EDITOR. The Ether and the Earth's Atmos- phere <i>Geo. Fras. Fitz Gerald</i> 390
EDITORIAL..... 382 The Vaccination Discussion in Eng- land.	

THE OPPONENTS OF VACCINATION in England have of late been more active than ever; and, as a result of their activity, a royal commissioner has been appointed, whose duty it shall be to make a full investigation of the whole subject, and submit a report thereon. Friends of vaccination should welcome such an inquiry, as the method stands upon such a firm foundation of facts as to be able to stand the most searching examination. If it has not accomplished all that is claimed for it, the failure is due to insufficient or inefficient performance of the operation; and the sooner such abuse of it is made public, the better. It is a rather remarkable coincidence that just at this time events should transpire at Sheffield, England, which show the value of vaccination. Small-pox has recently been very prevalent in that city. In a population of about 320,000 there have been 6,088 cases of the disease, of which number 590 proved fatal. Dr. Barry, who has made a report to the Local Government Board, finds that the attack-rate of the vaccinated children under ten was 5 in a thousand; of the unvaccinated of the same age, 101 in a thousand. The death-rates for the same classes were respectively .09 and 44. In every hundred-thousand of those twice vaccinated, there were eight deaths; once vaccinated, 100 deaths; and unvaccinated, 5,100 deaths.

SOAPING GEYSERS.¹

AT the Buffalo meeting, October, 1888, Dr. Raymond presented a paper entitled "Soaping Geysers," in which he called attention to the use of soap by tourists to cause eruptions of several of the well-known geysers in the Yellowstone Park. Incorporated in this paper appears a communication received from me, written from camp in the park, in reply to some inquiries on the subject. The letter discussed somewhat briefly the means employed by visitors to the park to hasten the eruptions from hot-springs and reservoirs of hot water, which remain dormant for days, or even weeks or months, at a temperature near the boiling-point, without any display of geyser-action. As the paper has called forth considerable comment, I desire to elucidate one or two points in relation to the temperature of the springs, and to answer some inquiries about the composition of the thermal waters.

In the summer of 1885, a Chinaman, employed as a laundryman for the accommodation of the tourists at the Upper Geyser Basin, accidentally discovered, much to his amazement, that soap thrown into the spring from which he was accustomed to draw his supply of water produced an eruption in every way similar to the actual workings of a geyser. Tourists with limited time at their command, who had travelled thousands of miles to look upon the wonders of the Yellowstone, soon fell into the way of coaxing the laundryman's spring into action, to partly compensate them for their sore disappointment in witnessing the periodical eruptions of Old Faithful. Successful attempts upon this spring soon led to various endeavors to accelerate action in the dormant and more famous geysers. In a short time, so popular became the desire to stimulate geysers in this way, that the park authorities were compelled to enforce rigidly the rule against throwing objects of any kind into the springs.

In connection with a thorough investigation of the thermal waters of the Yellowstone Park and the phenomena of the geysers, I undertook a number of experiments to ascertain the action of soap upon the waters, and to determine, if possible, those physical conditions of various pools and reservoirs which permitted the hastening of an eruption by the employment of any artificial methods. This investigation, conducted from time to time, as opportunity offered, throughout the field-season of 1885, included experiments upon the geysers and hot-springs of the Upper, Lower, and Norris Geyser Basins. The results proved, beyond all question, that geyser-action could be forced in a number of ways, but most conveniently by the application of soap. The greater part of the more powerful geysers undergo no perceptible change with a moderate use of soap, although several of them may, under favorable physical conditions, be thrown at times into violent agitation. In most of the experiments, Lewis's concentrated lye, put up in half-pound cans for laundry purposes, was employed. Each package furnished a strong alkali, equivalent to several bars of soap. In this form, alkali is more easily handled than in bars of soap, more especially where it is required to produce a viscous fluid in the larger reservoirs; and, in conducting a series of experiments for comparative purposes, it seemed best, in most instances, to employ the same agent to bring about the desired results.

Old Faithful, the model geyser of the park, exhibits such marked regularity in its workings, that attempts to hasten its action appear futile. The interval between eruptions is about 65 minutes, and rarely exceeds the extreme limits of 57 and 72 minutes. After an eruption of Old Faithful, the reservoir fills up gradually; the water steadily increases in temperature; and conditions favorable to another eruption are produced under circumstances precisely similar to those which have brought about the displays for the past eighteen years, or as far back as we have authentic records. The few experiments which have been made upon Old Faithful are insufficient to afford any results bearing on the question; but it seems probable that soon after the water attains the necessary temperature an eruption takes place.

Of all the powerful geysers in the park, the Bee-Hive offers the most favorable conditions for producing an eruption by artificial means, all the more striking because the natural displays are so fitful that they cannot be predicted with any degree of certainty.

¹ Abstract of a paper read before the American Institute of Mining Engineers. New York meeting, February, 1889, by Arnold Hague.

Observations extending over a period of several years have failed to determine any established law of periodicity for the Bee-Hive, even for three or four consecutive months; although they indicate that some relationship may exist between its display and those of the famous Giantess. Frequently the Bee-Hive will play several times a day, and then become dormant, showing no signs of activity for weeks and months, although the water may stand above the boiling-point the greater part of the time. The name "Bee-Hive" was suggested by the symmetry of the cone built around the vent. It rises about 4 feet above the sloping mound of geyserite, and in cross-section measures about 3 feet at the top, while at the bottom of the cone the vent is less than 10 inches in width. From the top of this narrow vent it is possible to sink a weight only 17 feet before striking a projecting ledge, which interferes with all examination of the ground below. The constant boiling and bubbling of the water, the irregularity of its action, and the convenient location of the geyser, within an easy walk from the hotel, make attempts to accelerate the eruptions of the Bee-Hive most attractive to tourists.

In most instances such efforts are futile: yet success does so frequently reward the astonished traveller, that, unless the geyser were carefully watched by the authorities, attempts would be made daily throughout the season. If the conditions are favorable to an eruption, it usually takes place in from 10 to 25 minutes after the addition of laundry-soap or lye. It is doubtful if more than two eruptions of the Bee-Hive have ever been produced on the same day by artificial means, although I know of no reason, based upon the structure of the geyser, why more displays might not be obtained; for the reservoir and vent fill up with boiling water very rapidly after each eruption.

Although the Giantess is situated only 400 feet from the Bee-Hive, these two differ in surface and underground structure, and mode of action, as widely as any two of the more prominent geysers of the park. Around the Giantess no cone or mound has formed. The broad basin is only partially rimmed in by a narrow fringe of silicious sinter, rising above and extending out over the deep blue water. At the surface, this basin measures about 15 to 20 feet in width by 20 to 30 feet in length. It has a funnel-shaped caldron, 30 feet in depth, ending in a vertical vent or neck 12 feet deep, through which a sounding-lead may be dropped into a second reservoir, meeting a projecting ledge or obstruction of some kind 61 feet below the surface. After an outburst of the Giantess, the basin, which has been completely emptied of its water, gradually fills again to the top; and for days before another eruption a steady stream of hot water overflows the brim. The intervals between the eruptions of the Giantess vary from twelve to twenty days, and the displays last several hours, being unsurpassed for violence and grandeur by any geyser in the Upper Basin. Artificial means have never been successful in bringing this geyser into action, although for days before an eruption it is an easy matter to cause an agitation of the water by throwing into the basin small pieces of sinter, or to produce a boiling on the surface, lasting several minutes, by simply stirring the water with a stick.

The Giant, one of the most violent of the geysers in the Upper Basin, more closely resembles the Bee-Hive than any other of those along the Firehole River. It has built up a cone 10 feet in height, one side of which has been partly broken down by some eruption more violent than any witnessed at the present day. Through this notched side, steam and broken jets of water are constantly emitted; and on this account but little examination has been made of the underground reservoirs and vents. The Giant is fitful in its action, at times playing with considerable regularity every fourteen days, and at other times lying dormant for nearly a year. I have no positive knowledge that an eruption of the Giant has ever been produced by any other than natural causes. At the time of my experiments, no eruption of the Giant had taken place for several months, although the water was constantly agitated; so much so, that it was quite impossible to examine the vent with any satisfactory results. The only effect produced by the application of lye was additional height to the column of water thrown out, and a decided increase in the thumping and violence of the boiling.

In the Lower Basin, the Fountain has been more carefully studied than the other geysers; and, its action and periodicity of

eruptions having been fairly well ascertained, it afforded the most favorable conditions for observing the action of soap and lye upon the waters. In its general structure, the Fountain belongs to the type of the Giantess, having a funnel-shaped caldron, which, long before an eruption, overflows into an adjoining basin. At the time of my experiments upon the Fountain, the intervals between eruptions lasted about four hours. This interval allowed sufficient time to note any changes which might take place. My own experiments with lye yielded no positive results; although it seemed highly probable that action might be hastened by the application of soap or lye just before the time for an eruption, or when, for some cause, the eruption was overdue. I preferred to make the attempt to bring about an explosion before the usual time, only waiting until the water in the pool had nearly reached the boiling-point. All experiments failed. The previous year, when wishing to produce action for the purpose of photography, I was enabled to accomplish the desired result by vigorously stirring with a slender pole the water near the top of the vent connecting with the lower reservoir. In this instance, it should be said, the usual interval of time between eruptions had long since passed: the geyser was, so far as time was concerned, a half-hour overdue. My opinion now is that the experiments with lye failed because the temperature had scarcely reached the boiling-point.

The Monarch, in the Norris Basin, is quite unlike those already described, and affords evidence of being a much newer geyser. It is formed by two convergent fissures, on the line of a narrow seam in the rhyolite, probably coming together below the surface. The main vent measures about 20 feet in length, and at the surface 3 feet in width. But slight incrustation is found around the vent, the conditions not being very favorable to deposition. In this narrow fissure, the water, which ordinarily stands about 15 feet below the surface, constantly surges and boils, except immediately after an eruption. The intervals between eruptions vary somewhat from year to year; but at the time of these experiments the action was fairly regular, the geyser playing every four hours. I was successful in obtaining an eruption quite equal to the natural displays, which throw a column of water 50 feet into the air. Here at the Monarch there is no surface reservoir; and the narrow fissure, filled with loose blocks of rocks around which the water is in constant agitation, prevents all measurements of depth.

The results of the many experiments, not only upon active geysers, but upon a large number of hot-springs, determine fairly well the essential conditions which render it possible to bring about geyser-action by artificial means. Negative results are frequently as valuable for this inquiry as experiments yielding imposing displays.

Outside of a few exceptional instances, which could not be repeated, and in which action was probably only anticipated by a few minutes in time, geyser eruptions produced by soap or alkali appear to demand two essential requirements,—first, the surface-caldron or reservoir should hold but a small amount of water, exposing only a limited area to the atmosphere; second, the water should stand at or above the boiling-point of water for the altitude of the geyser-basin above sea-level. The principal factor which makes it possible to cause an eruption artificially is, I think, the superheated and unstable condition of the surface-waters. Many of the geysers and hot-springs present the singular phenomena of pools of water heated above the theoretical boiling-point, and, unless disturbed, frequently remain so for many days without exhibiting any signs of ebullition. It may not be easy to describe accurately these superheated waters; but any one who has studied the hot-springs and pools in the park, and carefully noted the temperatures, quickly learns to recognize the peculiar appearance of these basins when heated above the boiling-point. They look as if they were "ready to boil," except that the surface remains placid, only interrupted by numerous steam-bubbles, rising through the water from below, and bursting quietly upon reaching the surface.

Marcet, the French physicist, has specially investigated the phenomena of superheated waters, and has succeeded in attaining a temperature of 105° C. before ebullition. Superheated waters in nature, however, appear to have been scarcely recognized, except during the progress of the work in the Yellowstone Park, in con-

nection with a study of the geysers. The altitudes of the geyser basins above sea-level have been ascertained by long series of barometric readings, continued through several seasons. In conducting a series of observations upon the boiling-points of the thermal waters in the park, Dr. William Hallock, who had charge of this special investigation, determined the theoretical boiling-point by noting the mean daily readings of the mercurial column. The exact boiling-point of a pure surface-water, obtained from a neighboring mountain-stream, and the boiling-point of the thermal waters from the springs, were determined from actual experiments by heating over a fire, employing every possible precaution to avoid sources of error. Surface-waters and deep-seated mineral waters gave the same results, and coincided with the calculated boiling-point at this altitude. Hundreds of observations have been carefully taken where the waters in the active and running springs boiled at temperatures between 198° and 199° F.

As will be shown later in this paper, the thermal waters are solutions of mineral matter too dilute to be affected to any appreciable extent as regards their boiling-point by their dissolved contents. The theoretical boiling-point for the springs and pools in the Upper Geyser Basin may be taken at 92.5° C. (198.5° F.). In many of the large caldrons, where the water remains quiet, a temperature has been recorded of 94° C. (201.2° F.) without the usual phenomena of boiling. This gives a body of superheated water, with a temperature at the surface of 1.5° C. (2.7° F.) above the point necessary to produce explosive action. Thermometers plunged into the basins show slightly varying temperatures, dependent upon their position in the basin. They indicate the existence of numerous currents, and a very unstable equilibrium of the heated waters, which are liable, under slight changes, to burst forth with more or less violence. It is under these conditions that geyser-action can be accelerated by artificial means. If into one of these superheated basins a handful of sinter pebbles be thrown, or the surface of the water be agitated by the rapid motion of a stick or cane, or even by lashing with a rope, a liberation of steam ensues. This is liable to be followed by a long boiling of the water in the pool, which in turn may lead to geyser-action. There is some reason to believe that, at least in one instance, an eruption has been brought about by a violent but temporary gust of wind, which either ruffled the water or disturbed the equilibrium of the pool, and changed momentarily the atmospheric pressure.

In Iceland, travellers have long been accustomed to throw into the geysers turf and soft earth from the bogs and meadows which abound in the neighborhood, the effect produced being much the same as that of sinter pebbles and gravel upon the geysers in the National Park. So well was this understood, that at one time a peasant living near the Iceland locality kept a shovel solely for the accommodation of those visiting the geysers.

In my letter to Dr. Raymond, I mention the curious fact that the laundryman's spring, now known as the Chinaman, in which geyser-action may most easily be produced by artificial means, has never been regarded by the Geological Survey as any thing but a hot-spring; and no one has ever seen it in action without the application of soap, except in one instance, when it was made to play to a height of twenty feet after stirring it vigorously with a pine bough for nearly ten minutes. In our records it is simply known as a spring.

If soap or lye is thrown into most of the small pools, a viscous fluid is formed; and viscosity is, I think, the principal cause in hastening geyser-action. Viscosity must tend to the retention of steam within the basin, and, as in the case of the superheated waters, where the temperature stands at or above the boiling-point, explosive liberation must follow. All alkaline solutions, whether in the laboratory or in nature, exhibit, by reason of this viscosity, a tendency to bump and boil irregularly. Viscosity in these hot-springs must also tend to the formation of bubbles and foam when the steam rises to the surface; and this, in turn, aids to bring about the explosive action, followed by a relief of pressure, and thus to hasten the final and more powerful display. Of course, relief of pressure of the superincumbent waters upon the column of water below the surface basin is essential to all eruptive action. These conditions, it seems to me, are purely physical. Undoubtedly the fatty substances contained in soap aid the alkali in ren-

dering the water viscous. On the other hand, when concentrated lye is used, it acts with greater energy, and furnishes a viscous fluid where soap would yield only surface suds, insufficient to accomplish any phenomenal display.

It is well known that saturated solutions of mineral substances raise the boiling-point very considerably, the temperature having been determined for many of the alkaline salts. In general, I believe the boiling-point increases in proportion to the amount of salt held in solution. Actual tests have shown that the normal boiling-point of silicious waters in the park does not differ appreciably from the ordinary surface-waters; mainly, I suppose, because they are extremely dilute solutions.

The amount of lye required to produce a sufficiently viscous condition of the waters increases but slightly the percentage of mineral matter held in solution.

All the waters of the principal geyser-basins present the closest resemblance in chemical composition, and, for the purposes of this paper, may be considered as identical in their constituents. They have a common origin, being, for the most part, surface-waters which have percolated downward for a sufficient distance to come in contact with large volumes of steam ascending from still greater depths. The mineral contents of the hot-springs are mainly derived from the acid lavas of the park plateau, as the result of the action of the ascending steam and superheated waters upon the rocks below. These thermal waters are essentially silicious alkaline waters, carrying the same constituents in somewhat varying quantities, but always dilute solutions, never exceeding two grams of mineral matter per kilogram of water. When cold, they are potable waters, for the most part slightly alkaline to the taste, and probably wholesome enough, unless taken daily for a long period of time.

Dr. Raymond has made the suggestion that the addition of caustic alkali would possibly precipitate some of the mineral ingredients found in these waters, thereby changing their chemical composition sufficiently to affect the point of ebullition. At the same time he remarks that the geyser-waters are probably too dilute solutions to be much influenced by such additions. Any one who glances at the analyses of the waters of the Bee-Hive, Fountain, and Fearless must see, I think, that they are not only too dilute to undergo any marked change of temperature, but that the mineral constituents consist mainly of the carbonates and chlorides of the alkalis, associated with a relatively large amount of free silica, which would remain unacted upon by caustic alkali. There is nothing in the waters to be thrown down by the addition of alkali, or to permit any chemical combinations to be formed by the addition of a small amount of soap. The desire of tourists to "soap a geyser" during their trip through the park grows annually with the increase of travel; so much so, that there is a steady demand for the toilet-soap of the hotels. If visitors could have their way, the beautiful blue springs and basins of the geysers would be "in the suds" constantly throughout the season. Throwing any thing into the hot-springs is now prohibited by the government authorities. It is certainly detrimental to the preservation of the geysers, and the practice cannot be too strongly condemned by all interested in the National Reservation.

THE EAST GREENLANDERS.

CAPT. HOLM'S expedition to East Greenland was as remarkable on account of its geographical results as in regard to the ethnological observations made among the isolated tribes of the northern parts of the east coast of Greenland. The results of his journey have been published, and form the tenth volume of the "*Meddelelser om Grönland*." In a recent number we referred to the linguistic and folk-loristic papers. Of no less importance are the general anthropometric and ethnographical results of the expedition.

Dr. Søren Nansen has submitted the craniological material and the measurements of Capt. Holm to an elaborate discussion, from which we glean the following facts. The whole population consisted of 548 heads, 245 of whom were males, while 303 were females. The size of the people is below the average, being 1,647 millimetres; while in the southern parts of the coast the average

size is only 1,604 millimetres on the east coast, and 1,547 on the west coast. The people of East Greenland are not as dolichocephalic as those of other regions, the length-width index of men being 76.9; that of women, 75.6. The face is oval, the lower part being comparatively large. The superior facial index is 103.8; the gonio-zygomatic index, 82.3, — two important figures, as they are the highest of all known indices. The form of the nose varies considerably, but is generally narrow and prominent, frequently aquiline.

Capt. Holm's description of the customs of this people is full of interest. His graphic description is made still more useful by a number of excellent lithographic plates, in which implements and works of art are represented.

During winter, the people of this region inhabit stone houses. In each inhabited place there is only one house, in which as many as ten families dwell. The oldest man acts as chief, as he is or has been a good hunter, and has sons who are good hunters. This position of senior chief rests probably upon a tacit acknowledgment of his authority, which is shown by the fact that he receives visitors, and represents all the inhabitants of the house. The ties of consanguinity are considered as imposing the duty of mutual assistance. Marriage, on the other hand, is not considered a binding tie. It is only after she has had children, that the wife's position becomes somewhat more firmly established. The husband is the chief of the family. Next to him are his sons, even when quite young, because they are considered the future hunters, who provide for the wants of their parents in old age. While the parents are alive, the sons live with them, and feed and clothe them.

The natives of this region frequently marry before they are grown up, as soon as a young man is able to provide for his wife. Good hunters have frequently two wives. As one woman cannot prepare all the skins obtained by the hunter, he frequently takes a second wife at the demand of the first. Sometimes his object in taking a second wife is to have two oarsmen for his boat. No instance is known of a man having more than two wives.

After death, the corpse is clothed in the best winter garments. Men are clothed in their kayak jacket. The head is covered with a hood, the limbs are tied up, and the corpse is dragged without any ceremony through the long passage of the house, or, if this is too difficult, it is removed through the window. If one of his ancestors has perished in the kayak, the corpse is thrown into the sea or deposited on the beach, where it is covered by the rising tide. In winter it is thrown through a hole cut through the ice. Sometimes, at least in former times, the dead were buried under boulders. The principal implements of the dead are deposited by the side of the grave.

The natives have numerous mourning ceremonies, which consist principally in lamentations and in abstaining from certain kinds of food. The name of the deceased is never mentioned. For this reason, if two men have the same name, the survivor must take a new one. If the deceased had the name of an animal or some other object, the word designating this animal must be changed. Thus the language undergoes material changes, as these new words are adopted by the whole population. But the old words frequently re-appear when the dead one has been forgotten.

Man is believed to be composed of three parts, — the body, the soul, and the name. The soul is small, not larger than a finger, and lives in the body of the man. When it falls sick, the man also falls sick; and if it dies, the man also dies. After the death of a man, his soul revives, either in heaven or in the sea. Both lives after death are considered good, but the former is preferable.

The name is as large as a man, and enters the child when, after birth, it is wiped with some water around the mouth, the names of the deceased after whom it is to be called being pronounced at the same time. When a man dies, the name remains near the corpse, in the water or on the land, until a child receives the name of the deceased. Then it enters the child, and there continues to exist. Still-born children are in heaven, where they produce the northern lights.

The Eskimo of East Greenland believe in a great number of spirits, which, however, are visible only to the angekok, the shamans of the Eskimo. The sea-animals are governed by a giant woman, in whose hair hang seals, narwhals, and other animals.

When the angekok is led to her by his guardian spirit, and he combs her hair, the animals come to the coast. Another important spirit is Tornarsuk, who also lives in the sea. He is described as being as tall as a large seal, and partly resembles a seal, partly a man. He swims rapidly through the depths of the sea.

There is an interesting legend which is found all over arctic America. It refers to the Erkilik, the upper part of whom is of human shape, while their feet are those of dogs. It is said that these Erkilik and the Europeans are the descendants of a woman who had married a dog.

These spirits, and the many others of whom the Eskimo tell, are not the subjects of any worship; but, in order to prevent them from doing harm to man, amulets are worn, which are believed to be a means of protection against sickness, and which secure long life to the wearer. Besides this, magic formulas are used in cases of sickness or to avert dangers. These formulas are also used to do harm to one's enemies. They are very ancient, and are transmitted from generation to generation. They are considered particularly effective when applied for the first time by a certain individual, while in course of time they lose in value and power. For this reason they are recited only in cases of imminent danger. They are spoken slowly, and in a low voice. The meaning of the words is entirely unknown.

Every angekok has his Tornarsuk and a being that is intermediate between himself and this Tornarsuk. In order to be a skilful angekok, it is necessary to have command over a great number of spirits. Besides, the angekok must be an expert in jugglery, he must have always a ready answer, and be able to make a diabolical impression upon his audience so as to strongly excite their nerves. The help of the angekok is asked for securing good luck in hunting, to procure favorable winds, and to cure sickness. They are not conversant, however, with the medicinal properties of any plant or mineral, but their operations are confined to treating the soul of the sick person.

It is the belief of the Eskimo that all diseases are due to the soul, which may be hurt or stolen by a sorcerer or by an angekok. It becomes, therefore, the duty of the angekok to find its whereabouts. His guardian spirit informs him of the cause of the disease, and of what has happened to the soul. If it has left the body, the angekok, by the help of his guardian spirit, makes marvellous journeys to recover it.

Besides the angekok, there are real sorcerers, whose principal object it is to do harm to their enemies. They are particularly able to construct the Tupilak, — a fabulous animal, artificially made of bone, skin, and flesh, which is to destroy the enemy of its master. The practices of sorcery of these men are numerous and of varied description; but the greater number are wholly imaginary. They have still other means of doing damage to their enemies; for instance, by using the flesh of a corpse. A man may be a sorcerer without carrying out his art, but then he is liable to fall into fits. In such cases he is slowly starved, and heavy stones are placed on his belly until he dies. This torture is often shortened by throwing the sick one into the sea. The only means of one escaping this treatment is by confessing that he is a sorcerer, and telling all his real and imaginary crimes. It is believed that thus he loses his supernatural powers.

The natives of the east coast of Greenland have an interesting tale stating that Greenland is an island. They say that long ago a man named Uyartek made a journey around the island. In the tale of this voyage, a point is named the end of the land. According to the description, this point is in about 68½° north latitude. Before coming there, a large fiord is said to intersect the coast.

They account for the existence of glaciers in the following way: When the land first made its appearance, there were neither sea nor mountains, but all was an enormous plain. As man was bad, the one in heaven destroyed the earth. Chasms opened, in which man perished. Then the water covered every thing. When land appeared for the second time, it was covered all over with glaciers. Two beings fell from heaven, who repeopled the earth. Since that time the glaciers have continually retreated. There are many places in which traces of their having been once covered by the sea may be seen.

The art of carving is very highly developed. It is a remarkable

fact that in this respect the extreme eastern Eskimo are very much like the inhabitants of Alaska. Among the implements collected by the expedition, are a great number of excellent carvings,—boxes, harpoon-staffs, and other implements, covered all over with carved figures. On all kinds of objects a single ornament is found, representing a seal. Mr. Holm believes that the high development of this art favors the opinion of Dr. H. Rink, who thinks that the East Greenlanders visited the coast coming from the north. He mentions the following facts as favoring this theory: the occurrence of deserted habitations in the northern parts of East Greenland; the undoubted fact that a number of animals reached the east coast coming from the north; and the tale of Uyartek, who travelled all around Greenland. The high development of the art of the East Greenlanders leads him to think that they were in contact with the far-distant Alaskan tribes at a comparatively recent date, while they must have been separated for a long time from the West Greenlanders.

THIRD ANNUAL REPORT OF THE DAIRY COMMISSIONER OF NEW JERSEY.

THE third annual report of the dairy commissioner of New Jersey, being the report for 1888, is full of interesting material. Dr. William K. Newton's long experience in work of this kind renders his reports of great value to all health-officers engaged in discovering the many frauds practised on consumers. Of 623 articles of food analyzed, 303, or 48.64 per cent, were adulterated or below the legal standards. We have not space in which to consider them all in detail, but will select a few of the most important. Of butter and oleomargarine, 68 samples were examined, and 44 of them were found to be adulterated or not standard. Many samples were submitted supposed to be oleomargarine, but they proved to be bad butter. Dr. Newton says that it may be stated as an invariable rule, that if the suspected material is rancid, and has a disagreeable odor, it is inferior butter, and not oleomargarine. The latter may become granular, and have a disagreeable, greasy taste; but it never turns rancid. Of 121 samples of milk, 43 were not as required by law. Adulteration is now practically confined to the large cities. The general milk is excellent. Of 55 samples of American canned goods analyzed, but one was found not up to the standard. During the year, of tomatoes alone, 3,319,437 cans were packed in the United States, 789,363 of them being put up in New Jersey. In speaking of the alleged danger from these goods, Dr. Newton says that it has been his practice for the past few years to investigate all reports of poisoning supposed to be due to the eating of canned articles, but in no instance has he found a well-authenticated case of poisoning. On this subject he says,—

"It is claimed that lead and tin have been found in large quantities in canned vegetables. My investigations have never revealed a single case where lead was in quantities large enough to detect. If that metal is present in these preserved foods, immediate steps should be taken to prevent the sale of articles so contaminated; for it is well known that the constant ingestion of very minute quantities of lead and some of its salts is almost invariably followed by symptoms of poisoning. And these symptoms are well marked, and known to every physician: hence, if there are cases of lead-poisoning due to this cause, a short time only would elapse before they would be placed on record. Lead is a cumulative poison, and is very slowly cast out by the system; but the ingestion of quantities as small as $\frac{1}{24}$ or $\frac{1}{100}$ of a grain, for a time is almost certain to be followed by symptoms of poisoning. I mention these well-known facts for the following reasons: first, if there have been cases of lead-poisoning caused by the use of canned foods contaminated with this metal, the medical profession would have, ere this, published accounts of the cases; second, the contrast between this metal and tin is so marked that the mere mention of the facts will be convincing.

"There is no doubt but that tin is frequently found in the articles preserved in vessels made of that metal. Especially so is this the case with acid vegetables like tomatoes, and the tables given show how often it has been revealed by the analyses just concluded. This being the case, the question is naturally asked, Is this metal poisonous, or are the quantities detected of any importance? Tin is commonly considered, next to iron, one of the most

innocuous of the baser metals. Nearly all of our culinary vessels are made of it, and their use is never followed by any ill results. All the evidence regarding the effects of tin on the system is negative. There are no recorded cases of poisoning, and, in fact, no mention is made in the authoritative works on toxicology of tin as a dangerous metal. The only instances where poisonous properties have been claimed for tin are in the records of cases of adulteration of molasses by a certain salt of that metal. Such cases were tried in the Massachusetts courts, but the evidence was not conclusive. We may, then, accept the facts in this relation, and state, that so far as scientific records now go, and so far as evidence is recorded, the quantity and quality of tin as found in canned foods are not injurious."

Mr. Shippen Wallace, chemist of the Board of Health, says that the fact cannot be too thoroughly impressed on the community, that the present system of canning vegetables is of inestimable value; but the same rules should be followed which are made use of with fresh vegetables in their use; that is to say, if, on opening a can, the contents are spoiled, act as one would with fresh vegetables under similar circumstances,—throw them away. This done, there is no possible danger in their use; but if not, the same risk is run as would be in the use of spoiled fresh vegetables, only to a greater extent.

In examining canned asparagus, a large amount of tin was found, and the interior of the can was invariably blackened. This may come from the acid in the asparagus, or from some ingredients used in the process of canning. From the results of the examination of asparagus packed in tin, it would seem to be demonstrated that this vegetable should be put up in glass only, and that the use of tin should be abandoned. Dr. Newton further says, that, of all cases of sickness caused by eating canned goods, the cause has always been found to have been that the contents were spoiled when opened, or the can had been allowed to remain open for a day or more before the contents were used.

Of six samples of ground coffee examined, 8 were pure and 16 adulterated. The adulterants were roasted and ground peas, beans, wheat, and chicory. The examination of tea showed that while there is no adulteration, there is a large amount of inferior and debased tea used in New Jersey.

Of 415 samples of drugs examined, 231 were found of inferior quality. Of 95 samples of cream-of-tartar, but 46 were up to the standard. Few articles are so commonly debased as this one. In speaking of this, Dr. Newton says,—

"The adulterations detected, in the greater number of debased samples, were clearly intentional, and were not due to lack of care in the methods of manufacture. An excess of tartrate or traces of chloride may well be considered as due to want of skill, or lack of care, in the maker; but the presence of sulphates, phosphates, alum, and flour can be accounted for in one way only, that is, they were added for fraudulent purposes.

"Several unique samples were examined. One, purchased at Beverly, contained no cream-of-tartar, but was a mixture of flour, acid phosphate of lime, and sulphate of lime; another sample of the same kind was sold to one of my agents at Cape May. A sample was sold by a dealer at Pemberton that proved to be a mixture of alum, phosphate of lime, and 64 per cent of cream-of-tartar. Several were obtained in different parts of the State that were adulterated with impure acid phosphate of lime.

"The samples that were equal to the standard were, in at least 90 per cent of the cases, obtained from druggists, but many from this source were badly debased. The impure cream-of-tartar obtained in this State came largely from the Southern and Western sections, and was sold to dealers by agents and jobbers from Philadelphia. There appears to be a certain relation between the fertilizer trade in that city and the bogus cream-of-tartar business, the connection probably being due to the trade in impure phosphates.

"Two suits were instituted against dealers in the very impure article, these being settled on the payment of costs, when the dealer promised to return the adulterated article to the wholesale dealer, and to sell only the pure article. Warning notices were sent to all other dealers detected in selling adulterated cream-of-tartar."

Forty-three samples of medicinal distilled liquors were examined, of which six answered to the tests given in the pharmacopœia and dispensatory, and thirty-seven were inferior. These distilled liquors were all purchased at drug-stores, and the dealer was presumed to know that they were intended for medicinal use. The price paid varied from the rate of four dollars to twenty dollars a gallon, yet this was not indicative of the quality.

The pharmacopœia defines brandy to be "an alcoholic liquid obtained by the distillation of fermented grapes, and at least four years old." It shall contain from 36 to 47 per cent, by weight, of alcohol, shall not contain any fusel-oil, nor shall the residue obtained by evaporation exceed 0.25 per cent. There should be no evidence that sugar or glycerine has been added, and it should contain a slight amount of tannin derived from the casks. None of the samples answered to these tests, and there was no proof that the article was of the proper age.

The difficulty of obtaining pure brandy of a proper age for medicinal use is very great. This is especially true of the imported article; while that made in California is, as a rule, of inferior quality, and not sufficiently aged and bland to be used in cases of illness. The following statement, made in the "United States Consular Reports," November, 1887, p. 333, is interesting in this connection:—

"The term 'brandy' seems to be no longer applied to a spirit produced by the fermentation of grapes, but to a complex mixture, the alcohol of which is derived from grain, potatoes, or, worst of all, the refuse of the beet-root refineries. It would seem to be fairly impossible at present to purchase a pure cognac. As each individual proprietor of a vineyard has become a distiller and compounder, he has acquired the art of imitating any special flavor or vintage of brandy that may be called for. Potato spirits and beet alcohols, the most deleterious and obnoxious of all the varieties of spirits, are sent from Germany into France in vast quantities. They are flavored, colored, and branded or labelled to meet the wishes of American connoisseurs. The mere fact of coming out of bond, or 'straight through the custom-house,' is generally accepted here as sufficient evidence that they are pure and genuine. It is rather unfortunate that physicians themselves frequently strengthen this hallucination in favor of imported spirits by giving the most stringent orders to their patients to procure genuine French cognac, even though it may command tenfold the price of an absolutely pure spirit of domestic production. This imperative command becomes a cruel injustice in the case of poor patients. Under the best of circumstances, what is there to be gained by the use of French brandy in preference to pure domestic spirit?"

And, it may be added to this statement, if alcoholic stimulants are to be prescribed by the physician, let him first ascertain the source of the sample, and acquaint himself with the quality, origin, and ingredients. The alcoholic strength in the samples analyzed varied from 37 to 47 per cent of alcohol by weight. Of the 15 samples of whiskey examined, 3 were equal to the requirements of the pharmacopœia. That authority defines this spirit as follows: "An alcoholic liquid, obtained by the distillation of fermented grain, generally corn, wheat, or rye, and at least two years old." Its alcoholic strength should be between 44 and 50 per cent by weight. It should contain no fusel-oil, not more than 0.25 per cent of residue on evaporation, and traces of tannin from the casks. The object sought by this description is to insure a properly made and aged liquor, and one without irritant or acrid properties.

The same objections to the use of impure or badly made whiskey obtain as were mentioned above, and physicians should not prescribe for use in cases of sickness a stimulant that fails to meet the pharmacopœial tests. The alcoholic strength of the samples examined varied from 34 to 48 per cent of alcohol by weight.

Of 42 samples of laudanum examined, only 8 were up to the standard. Dr. Newton's investigation revealed many important facts concerning the prevalence of the opium habit, and he was surprised to learn the amount of this potent drug, and its tincture, that is sold at country grocery-stores; but that the consumption of this article is great, and increasing, was no surprise when he ascertained how easily the article could be obtained, notwithstanding the State law that bottles containing the tincture should be

labelled, and not disposed of to irresponsible persons. He suggests that some action be taken that will check the sale of opium and its preparations to irresponsible persons, or without an order from a physician.

The report contains, in addition, an exhaustive inquiry into the baking-powders used in the State, which we shall notice at another time, and a list of decisions by the Supreme Court on the oleo-margarine law.

Residents of New Jersey may congratulate themselves on having so capable and watchful an officer as Dr. Newton at the head of this important department, and we regret that the same congratulations cannot be extended to the residents of many other States in the Union.

GOULD'S ORNITHOLOGICAL WORKS.

MESSRS. HENRY SOTHERAN & CO., of London and Manchester, having purchased from the executors of the late naturalist, Mr. John Gould, F.R.S., F.Z.S., the whole stock, lithographic drawings, copyright interests, etc., of his various works on natural history, announce the completion of this grand series of ornithological works by the publication of the twenty-fifth part of "The Birds of New Guinea and the Adjacent Papuan Islands." This series, comprising forty-three volumes, uniformly printed in imperial folio size, is now offered complete for one thousand pounds net.

A short biographical sketch of Mr. Gould appeared in *Nature* some time ago, from which it appears that John Gould was born at Lyme, in Dorsetshire, in 1804, and in early life passed several years under the care of the late Mr. J. T. Aiton, of the Royal Gardens at Windsor. In the year 1827 he went to London, and became taxidermist to the Zoological Society's museum, where he had the good fortune to obtain the intimate friendship of Mr. N. A. Vigors, then one of the leading English naturalists; and through him John Gould received his first opportunity of appearing as an author. So rare were Himalayan birds in those days, that a small collection was thought worthy of description by Mr. Vigors in the "Proceedings of the Zoological Society," and the figuring of these specimens was commenced by Mr. Gould under the title of "A Century of Birds from the Himalayan Mountains." By this time, however, an event had taken place which had an influence on the whole of his later life; viz., his marriage with Miss Coxen, the daughter of Mr. Nicholas Coxen of Kent. Besides her other accomplishments, Mrs. Gould was an admirable draughtswoman, and from her husband's sketches she transferred to stone the figures of the above-named work. Its success was so great that in 1832 the "Birds of Europe" was commenced, and finished in five large folio volumes in 1837; while simultaneously, in 1834, he issued "A Monograph of the Rhamphastidæ, or Family of Toucans," and, in 1838, "A Monograph of the Trogonidæ, or Family of Trogons." To the last he maintained his love for these birds, and one of his most recently finished works was a second edition of the last-mentioned monograph. It is a curious fact, that, when John Gould proposed to publish his first work, he applied to several of the leading firms in London, and not one of them would undertake to bring it out; so that it was only with reluctance that he began to issue the work on his own account. Besides these larger publications, he had described the birds collected during the voyage of the "Beagle" by his friend Mr. Darwin, and had contributed papers on other subjects to the Zoological Society's publications.

We now come to what is considered the most striking incident in Mr. Gould's life,—one unsurpassed in its effects in the annals of ornithology. Beyond a few scattered descriptions by some of the older authors, and an account of the Australian birds in the museum of the Linnæan Society by Messrs. Vigors and Horsfield, the birds of Australasia were very little known at the date mentioned. Accompanied, therefore, by his devoted wife, Mr. Gould proceeded in 1838 to study Australian birds in their own home; and he personally explored Tasmania, the islands in Bass's Straits, South Australia, and New South Wales, travelling four hundred miles into the interior of the latter country. This voyage, specially undertaken for the purpose of obtaining an exact knowledge of Australian birds, must ever be reckoned as a distinct scientific achievement; and the accounts of the habits of some of the more

remarkable species, such as the mound-building megapodes and the bower-birds, were quite triumphs in the way of field ornithology. Nests and eggs were collected, as well as an excellent series of skins, both of mammals and birds; and here Mr. Gould's beautiful method of preparation was especially noticeable. Some of his specimens, skinned more than thirty years ago, are as neat in appearance, and as fresh, as the day they were prepared. Returning in 1840, after two years' absence, he commenced the great work on the "Birds of Australia," which makes seven folio volumes, and occupied seven years in its production, being completed in 1848. One of the features of this work is the great increase in our knowledge of the range and habits of petrels and other sea-birds, to which the author paid great attention during his travels, and is by far the most important, from an ornithological point of view, of all Gould's works.

Within a year of Mr. Gould's return from his adventurous voyage, he had the misfortune to lose his wife, and for some time he was completely overwhelmed by his bereavement. His collectors in Australia too, about the same period, lost their lives. One of them, Mr. Gilbert, was killed during Dr. Leichhardt's expedition overland from Moreton Bay to Port Essington; and Mr. Drummond, while collecting in western Australia, was also murdered by natives; and a third collector was killed by the explosion of a gun on one of the islands of Bass's Straits. It speaks volumes, however, for the zeal and energy with which Mr. Gould had prosecuted his researches in the Australian continent, that very few birds (sufficient only to form a supplement in a single folio volume) have been discovered since he left the field of his labors in that quarter of the globe.

Another landmark in the career of this great ornithologist was the publication of his "Monograph of the Trochilidæ, or Family of Humming-Birds." These lovely little birds had been for a long time favorites with Mr. Gould, who gradually began to amass that fine collection which has been the admiration of naturalists for so many years. Taking advantage of the great exhibition of 1851, he obtained permission from the Zoological Society to erect, at his own cost, a large building in their gardens in the Regent's Park, where the collection was open to the public at a charge of sixpence per head. A considerable sum was realized by this exhibition, and a large number of subscribers to his monograph were obtained, including nearly all the royal families of Europe. Though sketched by Mr. Gould himself (for even to the last days of his life he executed the designs for all his plates), the majority of the humming-birds were placed on stone by Mr. Richter, who also did the same for Mr. Gould's next work, the "Birds of Asia." This work, though not completed at the time of his death, aged seventy-six, on Feb. 3, 1881, was brought to a satisfactory conclusion by Mr. R. Bowdler Sharpe, F.L.S., F.Z.S., etc., of the British Museum, acting on behalf of Messrs. H. Sotheran & Co., who have since brought his other unfinished works to completion, as hereafter mentioned. It is most valuable on account of the number of plates of species not figured elsewhere. The "Mammals of Australia," produced simultaneously with the last-mentioned work, deserved, in Mr. Gould's own opinion, more credit for its issue than perhaps any work he had done, because it touched upon a branch of zoology of which he never pretended to have any very exact knowledge. So large, however, had been his collections of *Mammalia* during his sojourn in Australia, that some account of them seemed to be demanded, and he therefore published his large folio work; but the pecuniary results were less satisfactory than with any of his ornithological productions. His typical specimens of the Australian *Mammalia* are in the national collection. No sooner were the humming-birds finished than his active brain conceived a new idea, to illustrate becomingly the birds of his native land, and he commenced the publication of the "Birds of Great Britain." Opinions may differ as to the merit of Mr. Gould's other works; volumes less ponderous than the folios which he adopted for the better figuring of the objects of the natural size may take their place with the student; but no work of greater beauty will be produced than that on which John Gould, returning in his later life to his first love, bestowed the fulness of his energy and the acme of his artistic talent. The care bestowed on the plates of this work was remarkable, the aim of the author being to produce a picture

of the birds as they appeared in their natural haunts; and especial pains were bestowed on the young, particularly those of the wading-birds and natatores. In this fine work most of the drawings were developed and placed on stone by Mr. W. Hart, who also executed all the plates of the later works.

In 1865, Mr. Gould republished his letterpress of the big work in an octavo form, under the title of "A Handbook to the Birds of Australia," but with all the additional species inserted in their proper families: these two volumes are therefore of great use to the student. After the completion of his work on "British Birds," Mr. Gould devoted himself to the continuation of the "Birds of Asia" and the supplement to the "Birds of Australia," until, in 1875, he commenced a work on the "Birds of New Guinea," which was to contain also descriptions of any new species that might be discovered in Australia or any part of the Australian region. Of the last-named work, eleven parts had appeared at his death, and it has since been completed by Mr. Bowdler Sharpe. The following works were also left unfinished: "A Monograph of the Pittidæ, or Ant-Thrushes of the Old World" (one part published); and the supplement to the "Monograph of the Humming-Birds," which has also been completed by Mr. Sharpe, with the co-operation of Mr. Osbert Salvin.

The above list enumerates all the works published by Mr. Gould, with the exception of the "Icones Avium" (issued about 1838, and containing supplementary plates to his previous volumes, with descriptions of new species), "A Monograph of the Odontophorinæ, or Partridges of America," "Synopsis of the Birds of Australia," and "A Monograph of the Macropodidæ" (published in 1841-42). In addition to the folio volumes, he was also in the habit of reprinting the introductions to his larger works in an octavo form for presentation to his friends.

BOOK-REVIEWS.

Hints for Teachers of Physiology. (Guides for Science-Teaching, No. XIV.) By H. P. BOWDITCH, M.D. Boston, Heath. 24°.

AT the present time physiology is taught in most of the grammar-schools; and the author has attempted to show how a teacher may supplement text-book instruction by means of simple observations and experiments on living bodies or on organic material, thus imparting to the pupils a knowledge of the foundation on which physiology rests, and at the same time bringing the impressions made on the senses to aid the memory in retaining the facts communicated in a purely didactic way. The reputation of Professor Bowditch as one of the foremost physiologists of America is a guaranty that the advice which he gives is based on scientific principles, and we heartily commend this manual to all teachers of physiology. Even those who are giving instruction to students more advanced than those in grammar-schools will find here many useful hints and suggestions.

The Leading Facts of French History. By D. H. MONTGOMERY. Boston, Ginn. 12°. \$1.25.

THIS work is intended for the use of schools, and is well adapted to its purpose. It treats, as its name implies, of the leading facts only, very few passages being filled with detail; and the story is in the main well told. The author's style is simple and easily understood, and the book is divided into sections with suitable headings for the student's use. Its principal defect is that it is almost exclusively a political history; the general progress of civilization, and the more special histories of literature, science, philosophy, and art, being almost wholly neglected. Mr. Montgomery puts on his titlepage the remark of Guizot, that "there is hardly any great idea, hardly any great principle of civilization, which has not had to pass through France in order to be disseminated;" but, owing to the scanty information furnished about the progress of civilization, this remark receives but slight illustration from this work.

The political history itself, however, is well treated, the really important topics being put in the foreground, while battles and court intrigues are relegated to their proper place. The earliest periods of French history are of course passed over somewhat lightly, but as much is said about them as most students will care for, and particular care is taken to show how the kingdom grew

from a comparatively small district around Paris to its full development. Coming down to later times, the author exhibits pretty clearly the growth of arbitrary power and of the unjust privileges of the nobles, and repeatedly dwells on the misery which these produced among the masses of the people. Thus he prepares the way for an understanding of the Revolution, which of course occupies a considerable share of attention. In this part of his work, however, it seems to us that he dwells rather too much on the horrors that were then enacted, and too little on the benefits that the Revolution ultimately brought. Napoleon is treated with justifiable severity, while at the same time his good deeds are duly acknowledged, and certain incidental benefits of his conquests are pointed out. The present condition of France is regarded as hopeful, and her prosperity as well grounded. Mr. Montgomery's work will be useful not only to students, but also to private readers who wish for a general sketch of French history unencumbered by useless details.

AMONG THE PUBLISHERS.

THE two articles on agnosticism, in *The Popular Science Monthly* for April and May, will be followed by two more in the June number. One of these is by Professor Huxley, in rejoinder to Dr. Wace and the Bishop of Peterborough; the other, by Mr. W. H. Mallock, is entitled "Cowardly Agnosticism," and criticises Professor Huxley's objections to the above phrase, expressed in his first article. "The Production of Beet-Sugar," including the method of growing the plant, and the processes employed in ex-

tracting the sugar, will be described by Mr. A. H. Almy. This account, together with the paper in the May *Monthly*, gives a complete view of an industry which has yielded large profits to the farmers of Germany, and promises to become equally important in this country. Widespread interest has been manifested in the article on "Christian Science," in the April *Popular Science Monthly*, and nowhere more than among the healers themselves. Of the several replies offered by members of this fraternity, the *Monthly* will publish one in the June issue, by Mr. J. F. Bailey, editor of the *Christian Science Journal*, under the title "Is Christian Science a Craze?" An editorial in the same number will clearly state the position of the magazine on this subject. "Glaciers on the Pacific Coast," is the title of an illustrated descriptive article, by Professor G. Frederick Wright, to appear in June.

— The articles on "The Practical Applications of Electricity," which begin in the June *Scribner*, will, it is announced, be as complete a picture of the present position of electricity in the industrial world as the Railway Series is of the great subject of transportation. The men who have been secured to write these articles are acknowledged authorities in the subjects of lighting, telegraphy, medical electricity, etc., including among their number President Morton of Stevens Institute; C. L. Buckingham of the Western Union; A. E. Kennelly, Mr. Edison's chief electrician; Dr. M. Allen Starr; and Professor Brackett of the Princeton Scientific School. W. A. Linn, of the New York *Evening Post*, has written for the number a complete popular account of the origin, growth, and present management of that form of co-operation known as

Publications received at Editor's Office,
April 29-May 4.

CLIMATOLOGY and Meteorology, List of Books and Articles on, in the Library of the Surgeon-General's Office, United States Army. (Extract from the Index Catalogue.) Washington, Government. 17 p. 8°. GUTTENBERG, G. A Course of Mineralogy, for Young People. Second Grade. Erie, Penn., The Author. 44 p. 16°.

D. APPLETON & CO.

HAVE JUST PUBLISHED

I. The Primitive Family in its Origin and Development.

By Prof. C. N. STARCKE, of the Copenhagen University. Volume LXV of the International Scientific Series. 12mo. Cloth, \$1.75.

II. How to Study Geography.

By FRANCIS W. PARKER, Principal Cook County (Illinois) Normal School. Volume X of the International Education Series. Edited by WILLIAM T. HARRIS, LL.D. 12mo. Cloth, \$1.50.

RECENTLY PUBLISHED.

The History of Ancient Civilization. A Hand-Book based upon M. Gustave Ducoudray's "Histoire Sommaire de la Civilization." Edited by the Rev. J. VERSCHOYLE, M.A. With Illustrations. Large 12mo. Cloth, \$1.75.

A Manual of Instruction in the Principles of Prompt Aid to the Injured. Designed for Military and Civil Use. By ALVAN H. DOTY, M.D., Major and Surgeon, Ninth Regiment, N. G., S. N. Y.; Attending Surgeon to Bellevue Hospital Dispensary. With 96 Illustrations. 12mo. Cloth, \$1.25.

A Treatise on Co-operative Savings and Loan Associations, including Building and Loan Associations, Mutual Savings and Loan Associations, Accumulating Fund Associations, Co-operative Banks, etc. With Appendix containing Laws of New York, Pennsylvania, and Massachusetts: Forms of Articles of Associations, By-Laws, Account Books, etc. By SEYMOUR DEXTER, President of "The Chemung Valley Mutual Association." 12mo. Cloth, \$1.25.

The Playtime Naturalist. By Dr. J. E. TAYLOR, F.L.S., Editor of "Science-Gossip." With 366 Illustrations. 12mo. Cloth, \$1.50.

Mental Evolution in Man. Origin of Human Faculty. By GEORGE JOHN ROMANES, F.R.S., author of "Mental Evolution in Animals," etc. 1 vol., 8vo. Cloth, \$3.00.

The Folk-Lore of Plants. By T. F. THISELTON DYER, M.A. 12mo. Cloth, \$1.50.

Nature and Man: Essays, Scientific and Philosophical. By the late WILLIAM BENJAMIN CARPENTER, M.D., F.R.S. With an Introductory Memoir by J. ESTLIN CARPENTER, M.A., and a Portrait. Large 12mo. Cloth, \$2.25.

At all Booksellers; or by mail on receipt of price.

I, 3, & 5 BOND STREET, NEW YORK.

LONGMANS, GREEN & CO.'S NEW BOOKS.

Lord Randolph Churchill's Speeches.

From 1880 to 1888. Revised and Corrected by himself. With an Introductory Review and Notes to the Speeches by Louis J. Jennings, M.P., editor of "The Croker Papers," etc. 2 vols., 8vo. \$7.00.

"Brilliant record of a brilliant decade."—*New York Tribune*.

"The reader will be favorably impressed with the consistency of these speeches."—*Observer*.

The Bird-Bride:

A Volume of Ballads and Sonnets. By Graham R. Tomson. Fcp. 8vo, \$1.75.

"The author is a born artist in verse. . . . Not one of the ballads but has the true glamour of imagination."—*Scottish Leader*.

"An altogether charming little volume, which lovers of the Muse will hasten to add to their collection."—*Globe*.

Lectures on Pathological Anatomy.

By Samuel Wilks, M.D., F.R.S., Consulting Physician to, and formerly Lecturer on Medicine and Pathology at, Guy's Hospital, and the late Walter Moxon, M.D., F.R.C.P., Physician to, and some time Lecturer on Pathology at, Guy's Hospital. Third Edition, thoroughly Revised. By Samuel Wilks, M.D., LL.D., F.R.S. 8vo, \$6.00.

Life of Charles Blacker Vignoles, F.R.S., F.R.A.S., M.R.I.A., &c.

Soldier and Civil Engineer, formerly Lieutenant in H.M. 1st Royals, Past-President of Institution of Civil Engineers. A Reminiscence of Early Railway History. By his son, Olinthus J. Vignoles, M.A., Assistant Minister of St. Peter's Church, London. With several Portraits and Illustrations. 8vo, \$5.00. (Dedicated to H.M. the Queen.)

On Parliamentary Government in England.

Its Origin, Development, and Practical Operation. By Alpheus Todd, LL.D., C.M.G. Second edition. In 2 volumes. Vol. II. 8vo. \$10.00. Very shortly. * Vol. I, 8vo, \$7.50.

For sale by all Booksellers. Sent on receipt of price by the Publishers,

LONGMANS, GREEN & CO., 15 East Sixteenth Street, New York.

Prince, Princess, and People;

An Account of the Social Progress and Development of our own Times, as illustrated by the Public Life and Work of their Royal Highnesses the Prince and Princess of Wales, 1863-1889. By Henry C. Burdett. With Portraits and Autographs of their Royal Highnesses and Illustrations of their Norfolk House. 8vo, \$6.00.

"Careful, conscientious and painstaking as a work of reference, and the author's style and treatment of his subject is marked not only by dignity and decorum, but by great tact and delicacy of feeling."—*Observer*.

Longmans' New Atlas.

Political and Physical, for the Use of Schools and Private Persons. Consisting of 40 4to and 16 8vo Maps and Diagrams, besides Insets and 16 4to Plates of Views, &c. Engraved and Lithographed by Edward Stanford. Edited by G. G. Chisholm. Imp. 8vo., \$4.00. 4to, \$4.50.

The Student's Atlas.

In Twelve Circular Maps on a Uniform Projection and one Scale, with two Index Maps. Intended as a *vade-mecum* for the Student of History, Travel, Geography, Geology, and Political Economy. By R. A. Proctor. With a letterpress Introduction illustrated by several cuts. 8vo, \$1.50.

"We have seldom had such a rare treat offered to us as the inspection of this beautiful volume has afforded. It is well-nigh impossible, in the small amount of space available to us, to dwell adequately upon all the various and novel features here represented."—*The Teachers' Aid*.

Social Progress: an Essay.

By Daniel Greenleaf Thompson, President of the Nineteenth Century Club of New York, Author of "The Problem of Evil," "The Religious Sentiments of the Human Mind," etc. 8vo, \$2.00.

"Mr. Thompson is an acute and careful observer himself, and a systematic student of the results put forward by other workers."—*Contemporary Review*.

"building and loan associations." The author is president of a prosperous association, and thoroughly familiar with the details of management. Professor Henry Drummond will make an earnest appeal for the United States to join in the work of suppressing slavery in Africa. He says, "America has never been provincial. She must not become so. So manifold and pressing are now the interests of her own great country, that she might also be pardoned if she did. But the world will be bewildered and disappointed if she separates herself now from the rest of mankind in facing those great wrongs of humanity from which seas cannot divide her, and which her poorer brethren in every part of Europe are giving themselves to relieve. America does well in refusing the entanglements of European politics. Let her be careful lest she isolate herself from its humanities. None who know her will fear for a moment that the breadth of her sympathies and the greatness of her national heart will not continue to be shown in her sustained philanthropies, in her joining hand to hand with the advanced nations of the earth in helping on all universal causes which find their appeal in the world's great need and tribulation." Although the series on electricity will begin in the June number, there are several more of the railway articles to appear. Mr. H. G. Prout, of the *Railway Gazette*, will write of "Safety Appliances;" and Benjamin Norton, second vice-president of the Long Island Railroad, will describe the purchasing and supply departments under the title "How to Feed a Railway."

— A sympathetic sketch of the work of Mr. Bright, by Dr. R. W. Dale, forms the opening paper of the *Contemporary Review* for May (New York, Leonard Scott Publication Company, 29 Park Row). Dr. Dale admits it is yet too early to determine what rank will be permanently attributed to Mr. Bright among English statesmen, but contends there need be no hesitation in expressing the profound impression which his great personal qualities have made upon his contemporaries. The paper is accompanied by two pages of facsimiles of notes of speeches made by Mr. Bright, together with a full report, thus affording an interesting insight into his method of work. Lord Chief Justice Fry contributes an interesting and suggestive paper on "Imitation as a Factor in Human Progress;" Thomas Burt, M.P., presents a review of the progress of labor politics as represented in the British Parliament; T. Vincent Tymm makes another addition to the agnostic controversy now taking so prominent a place in the English reviews, in a paper on "Agnostic Expositions;" Edward T. Cook brings together many curious facts concerning popular judgment of works of art in an article on "Prices at the National Gallery;" Mr. W. S. Lilly contributes the first of a series of papers on Mr. Herbert Spencer in a paper entitled "Our Great Philosopher;" Grant Allen writes on "Individualism and Socialism;" and C. S. Addis, on "Railways in China." The number concludes with a valuable symposium on "The Industrial Value of Technical Training," with opinions of practical men. The contributors include Lord Hartington, president of the National Association for the Promotion of Technical Education, and numerous representatives of manufacturers in England.

— The *Fortnightly Review* for May (New York, Leonard Scott Publication Company) opens with an essay by Lord Wolseley, entitled "Is a Soldier's Life worth Living?" which he answers in the affirmative; William Archer makes a plea for an endowed theatre, urging that such an institution would render possible the production of many plays that are now never seen; Arsene Housaye concludes his reminiscences of Alfred de Musset, begun in the April number; an unsigned paper, "What is Ritualism?" will doubtless attract a wide circle of readers; Professor Karl Blind contributes a series of personal recollections of John Bright; F. C. Selous describes the newly acquired Mashunaland, treating of an almost totally unknown portion of Africa; Lady Dilke contributes a paper on the foreign missions controversy, that has been prominent in this review, in a short article entitled "The Great Missionary Success;" Hamilton Aide has a thoughtful paper on "Color in Domesticity and Dress;" Thomas H. Thornton presents an interesting sketch of the development of English judicial and administrative history in a paper entitled "Two Centuries of Magistrates' Work in Surrey;" Col. Maurice criticises present systems of military training; and Professor Tyrrell views "Robert Elsmere as a Symptom," and finds serious fault with Mrs. Ward's literary style. The number concludes with an article by Cardinal Manning on "The Educational Commission and the School Rates," in which he argues for the extension of popular education.

LETTERS TO THE EDITOR.

*.*Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The Ether and the Earth's Atmosphere.

I HAVE read with much interest Messrs. Michelson and Morley's wonderfully delicate experiment attempting to decide the important question as to how far the ether is carried along by the earth. Their result seems opposed to other experiments showing that the ether in the air can be carried along only to an inappreciable extent. I would suggest that almost the only hypothesis that can reconcile this opposition is that the length of material bodies changes, according as they are moving through the ether or across it, by an amount depending on the square of the ratio of their velocity to that of light. We know that electric forces are affected by the motion of the electrified bodies relative to the ether, and it seems a not improbable supposition that the molecular forces are affected by the motion, and that the size of a body alters consequently. It would be very important if secular experiments on electrical attractions between permanently electrified bodies, such as in a very delicate quadrant electrometer, were instituted in some of the equatorial parts of the earth to observe whether there is any diurnal and annual variation of attraction, — diurnal due to the rotation of the earth being added and subtracted from its orbital velocity; and annual similarly for its orbital velocity and the motion of the solar system.

GEO. FRAS. FITZ GERALD.

Dublin, May 2.

INDUSTRIAL NOTES.

A Satisfactory Motor.

OVER a year ago the Spokane Falls Chronicle Company of Spokane Falls, Washington Territory, decided to operate their presses by electric power, and purchased a 2-horse-power Sprague motor for the purpose. Since that time, this motor has been running one standard Babcock cylinder press and two quarto job presses at the same time, giving great satisfaction. The proprietor of the *Chronicle* says that during this time it has not cost one cent for repairs, and is in every particular just as good as when it was installed, and that the Chronicle Company are perfectly satisfied with their electrical power.

Some Contracts closed Last Week.

During the past week the street-railway companies which are about adopting the electric system for operating their cars have not been idle, and the Sprague Electric Railway and Motor Company of New York report a number of new contracts closed during

the past week. One of these is at Plattsmouth, Neb., where the Plattsmouth Street Railway Company have closed their contract with the Sprague Railway and Motor Company at Kearney, Neb., for a complete electric-railway equipment. The Pennsylvania Railroad have been so well pleased with the operation of the Sprague cars at Atlantic City, N.J., that they have ordered ten more complete trucks. In Binghamton, N.Y., the Washington Street and State Asylum Railroad has closed a contract with the Sprague Company to equip their line with the latest improved railway appliances, and latest type of motors.

The list of roads which have closed contracts during the week ending May 11, 1889, is as follows: Atlantic City Electric Railroad, extension, Atlantic City, N.J.; Collamor Line, East Cleveland, O.; Key City Electric Railroad, Dubuque, Io.; Long Island and Newtown Electric Railroad, Long Island City, N.Y.; Plattsmouth Electric Railroad, Plattsmouth, Neb.; Union Electric Railroad, Sterling, Ill.; Washington Street and State Asylum Railroad, Binghamton, N.Y.

GUARANTY INVESTMENT COMPANY

CAPITAL \$250,000.

Hon. ALBERT H. HORTON (Chief Justice, Kansas Supreme Court), Topeka, Kan., Pres't.

7% Guaranteed Farm Mortgages 7%

The Company calls the special attention of Investors to the following points :

- I. All loans guaranteed and interest payable semi-annually at the Importers' & Traders' National Bank, New York.
- II. Unusual fulness of information, not only about the security itself, but about the general development of the section where the farm is located.
- III. An examination each year of the general business of the Company and the Mortgages themselves by a COMMITTEE OF INVESTORS sent for the purpose.
- IV. Many hundred Mortgages taken and NOT A SINGLE FORECLOSURE.
- V. Exhibitions in New York at frequent intervals, of Kansas and Nebraska Farm Products. The Exhibition at the American Institute in the fall of 1888, received the *HIGHEST AWARD* of superiority.
- VI. Monthly Bulletins giving full information about all Mortgages offered for sale.

Address for Monthly Bulletin and Investors' Committee Report for 1888,

HENRY A. RILEY, General Eastern Manager, 191 Broadway, N.Y.

¹⁶PAGES. **THREE** ¹⁶PAGES.

Hundred Thousand new subscribers for *The Family Journal and Ladies' Companion* wanted. It is the most interesting and instructive paper ever issued. Subscribers will receive during the coming twelve

MONTHS

novels written by American Authors, complete in each three numbers. The story of popular works of fiction will be retold by a novel reader, the most interesting and unique feature ever introduced in any publication, giving the substance of popular and standard books by famous writers in a space easily read by the busiest people. We have engaged

FOR

this work a widely known and popular writer. Comments on Current Events, Fashions, New and Original Ideas and Designs for Ladies' Fancy Work and Household Decoration, Letters from Correspondents and their Answers. The colleges and seminaries of the United States will be treated one each month in an illustrated article, showing the particular advantage of each, cost of attendance, etc. Invaluable to parents having sons or daughters whom they desire should receive the advantages of a higher education than the ordinary school affords. Articles on Painting and Drawing, giving home instruction by a well-known artist. A trial subscription of this elegant paper will be sent to any address, three months, for

TEN CENTS.

Liberal pay for literary work adapted to our columns, and for new and original drawings, designs and ideas on any subject which we can use.

Premium list the most complete in the world. We offer inducements to club raisers and agents approached by no other publishing house. The celebrated Gilbert Cut Waist Linings, which we send post paid to any one sending us two yearly subscribers at 50 cents each is alone worth 75 cents.

Sent to any address, postpaid one year, 50 cents; six months, 25 cents, and a three months' trial subscription for only 10 cents.

TRY IT! TRY IT! TRY IT!

and you will become a permanent reader. Address:

John L. Douglass, Publisher,
322 Broadway, N. Y.

ESTABLISHED 1859.

H. A. DREW,
Commercial Printer,
5 Clinton Place, near Broadway,
New York.

Wedding Orders, Souvenirs, Invitations, Orders of Dance, etc., etc., done in the latest and most elaborate styles, at reasonable prices.

All Favors promptly attended to.

Correspondence solicited with parties seeking publishers for scientific books.

N. D. C. HODGES,

Publisher of Science,
47 Lafayette Place,
New York.

"The Week, one of the ablest papers on the continent."—*Descriptive America.*

ENLARGED AND IMPROVED.

THE WEEK:

A Canadian Journal of Politics, Literature, Science and Arts.

PUBLISHED EVERY FRIDAY.

\$3.00 per Year.

\$1.00 for Four Months.

THE WEEK has entered on its SIXTH year of publication, greatly enlarged and improved in every respect, rendering it still more worthy the cordial support of every one interested in the maintenance of a first-class literary journal.

The independence in politics and criticism which has characterized THE WEEK ever since its first issue will be rigidly maintained; and unceasing efforts will be made to improve its literary character and increase its value and attractiveness as a journal for the cultured home. Many new and able writers are now, or have promised to become, contributors to its columns, and the constant aim of the Publisher will be to make THE WEEK fully equal to the best literary journals in Britain and the United States.

As heretofore, PROF. GOLDWIN SMITH will, from time to time, contribute articles. London, Paris, Washington and Montreal letters from accomplished correspondents will appear at regular intervals. Special Ottawa Letters will appear during the sessions of Parliament.

THE WEEK in its enlarged form will be the same size as "Harpers' Weekly," and the largest paper of its class on the continent.

SEND FOR FREE SAMPLE COPY.

C. BLACKETT ROBINSON, Publisher,
5 Jordan St., Toronto.

Readers of Science

Corresponding with or visiting Advertisers will confer a great favor by mentioning the paper.

Schools.

The Sauveur Summer College OF LANGUAGES.

(Removed from Amherst, Mass., and Oswego, N.Y.,
to BURLINGTON, VT.)

The Normal Class will be taught for the French by
Dr. Sauveur, for the German by Dr. W. Bernhardt,
for the Latin by Prof. J. U. Dillard. Fourteenth
Session: July 8 to August 16.

Dr. Sauveur's new work, *LES CHANSON'S DE
BERANGER*, with *Historical Commentary and
Notes*, will be ready June 1, and taught at the
School. For Circulars address

DR. L. SAUVEUR,

Copley Terrace, Roxbury, Boston, Mass.

N.B.—Circulars of Dr. L. SAUVEUR Educational
Works will be sent free to applicants.
[Mention this paper.]

CONNECTICUT, NEW HAVEN,

MRS. CADY'S SCHOOL FOR YOUNG LADIES.
Prepares for Smith and Wellesley, and admits to
Vassar by Certificate. Circulars. Early application
necessary.

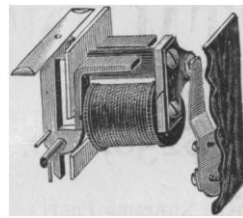
NEW JERSEY, PLAINFIELD.

THE CHESTNUTS.—Parents with daughters to edu-
cate, or orphan girls with companion, may find a
comfortable home, with school instruction by applying to
Miss E. E. Kenyon.

A NEW MAGAZINE—THE SWISS CROSS

Devoted to spreading a love of
nature among the people. Edited
by HANLAN H. BALLARD, President of the Agassiz Asso-
ciation, and succeeding *St. Nicholas* as the official maga-
zine of that body. \$1.50 a year. Sample copy 10 cents, or 25
cents for trial subscription for 3 months.

N. D. C. HODGES, PUBLISHER,
Mention this paper. 47 Lafayette Place, New York.



A
★
DROP
IN THE
PRICE
★
OF

GRAVITY DROP ANNUNCIATORS.

DON'T FORGET THE
DUST-PROOF BELLS.

HAZAZER & STANLEY,
32 Frankfort Street, N. Y.

Any one who will have the following blank filled out by a
responsible Newsdealer, and mailed to us, will be allowed a
three months' subscription to *Science*.

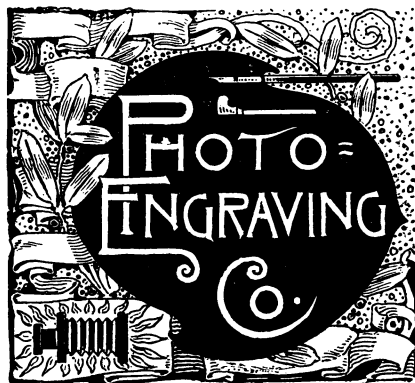
N. D. C. HODGES,

47 LAFAYETTE PLACE, NEW YORK.

1889.

To the News Company.

You may add to my regular order five copies of *SCIENCE*
each week (returnable).



BRANCH AT 728 CHESTNUT ST.
PHILADELPHIA, PA.

JOHN HASTINGS =
Pres't.

A. R. HART =
Gen. Manager

JOS. TRIPP.
V. Pres't.

ENGRAVING FOR
ALL ILLUSTRATIVE
AND ADVERTISING
PURPOSES

67-71 PARK PLACE
NEW YORK

SCIENCE CLUBBING RATES.

10% DISCOUNT.

We will allow the above discount
to any subscriber to *Science* or
The Swiss Cross who will send
us an order for periodicals exceeding
\$10, counting each at its full price.

	Year's Subscription.	With Science.	With The Swiss Cross.
Agricultural Science.....	\$ 2.50	\$ 5.30	\$ 4.50
American Agriculturist.....	1.50	4.30	2.50
American Analyst.....	1.00	4.25	2.25
American Architect and Building News.....			
Imperial edition.....	10.00	12.80	11.00
Gelatine ".....	7.00	9.80	8.00
Regular ".....	6.00	8.80	7.00
American Garden.....	1.00	4.25	2.25
American Journal of Philology.....	3.00	6.25	4.25
American Machinist.....	2.50	5.30	4.50
American Naturalist.....	4.00	7.50	5.50
Andover Review.....	4.00	6.80	5.00
Atlantic.....	4.00	6.80	5.00
Babyhood.....	1.50	4.30	2.50
Babyland.....	.50	3.75	1.75
Bradstreet's.....	5.00	7.80	6.00
Brain.....	3.50	6.30	4.50
Building (weekly).....	6.00	8.80	7.00
Carpentry and Building.....	1.00	4.25	2.25
Century Magazine.....	4.00	6.80	5.00
Chautauquan, The.....	1.50	4.30	2.50
Christian Union, The.....	3.00	5.80	4.00
Christian Weekly, Illustrated.....	2.50	5.30	3.50
Cosmopolitan, The.....	2.00	4.80	3.00
Critic.....	3.00	5.80	4.00
Eclectic Magazine.....	5.00	7.80	6.00
Edinburgh Review.....	4.00	6.80	5.00
Electrical World.....	3.00	5.80	4.00
Electrician and Electrical Engineer. Electrical Review.....	3.00	5.80	4.00
Engineering and Mining Journal.....	4.00	6.80	5.00
English Illustrated Magazine.....	1.75	4.55	2.75
Forest and Stream.....	4.00	6.80	5.00
Forum, The.....	5.00	7.80	6.00
Godey's Lady's Book.....	2.00	4.80	3.00
Harper's Bazar.....	4.00	6.80	5.00
Harper's Magazine.....	4.00	6.80	5.00
Harper's Weekly.....	4.00	6.80	5.00
Harper's Young People.....	4.00	6.80	5.00
Health and Home.....	1.00	4.25	2.25
Herald of Health.....	1.00	4.25	2.25
Illustrated London News (Amer. reprint).....	4.00	6.80	5.00
Independent, The.....	3.00	5.80	4.00
Inter Ocean, The.....	1.00	4.25	2.25
Iron Age (weekly).....	4.50	7.30	5.50
Journal of Philology (Eng.).....	2.50	5.30	3.50
Journal of Speculative Philosophy (begins with Jan. No.).....	3.00	5.80	4.00
Judge.....	4.00	6.80	5.00
L'Art.....	12.00	14.80	13.00
Life.....	5.00	7.80	6.00
Lippincott's Magazine.....	3.00	5.80	4.00
Littell's Living Age.....	8.00	10.80	9.00
Little Men and Women.....	1.00	4.25	2.25
London Quarterly.....	4.00	6.80	5.00
Macmillan's Magazine.....	3.00	5.80	4.00
Magazine of American History.....	5.00	7.80	6.00
Medical and Surgical Journal.....	5.00	7.80	6.00
Mechanical Engineer.....	2.00	4.80	3.00
Metal Worker.....	1.00	4.25	2.25
Microscope, The.....	1.00	4.25	2.25
Nature.....	6.00	8.80	7.00
New Princeton Review.....	3.00	5.80	4.00
North American Review.....	5.00	7.80	6.00
Outing.....	3.00	5.80	4.00
Overland Monthly.....	4.00	6.80	5.00
Pansy.....	1.00	4.25	2.25
Political Science Quarterly.....	3.00	5.80	4.00
Popular Science Monthly.....	5.00	7.80	6.00
Popular Science News.....	1.00	4.25	2.25
Portfolio, The.....	7.50	10.30	8.50
Practitioner.....	3.50	6.30	4.50
Public Opinion.....	3.00	5.80	4.00
Puck.....	5.00	7.80	6.00
Puck (German).....	5.00	7.80	6.00
Quarterly Review (London).....	4.00	6.80	5.00
Queries.....	1.00	4.25	2.25
Rural New-Yorker.....	2.00	4.80	3.00
St. Nicholas.....	3.00	5.80	4.00
School Journal.....	2.50	5.30	3.50
Scientific American.....	3.00	5.80	4.00
Supplement.....	5.00	7.80	6.00
Architect and Builders' edition.....	2.50	5.30	3.50
Scribner's Magazine.....	3.00	5.80	4.00
Southern Cultivator.....	1.50	4.30	2.50
Springfield Republican (weekly).....	1.00	4.25	2.25
Sunday School Times.....	2.00	4.80	3.00
Teachers' Institute.....	1.25	4.05	2.25
Texas Siftings.....	4.00	6.80	5.00
Trained Nurse.....	1.50	4.30	2.50
Treasure Trove.....	1.00	4.25	2.25
Truth Seeker, The.....	3.00	5.80	4.00
Wide Awake.....	2.40	5.20	3.40
Young Folks' Journal.....	1.00	4.25	2.25

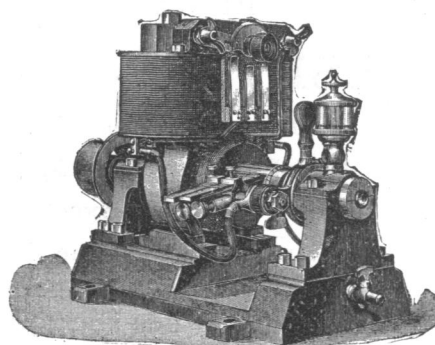
N. D. C. HODGES,

47 Lafayette Place,

New York.

C. & C. ELECTRIC MOTOR COMPANY.

Electric Motors
FOR
Arc and Incandescent Cir-
cuits, Most Economi-
cal Motor on the
Market.
Regulation Perfect.
Motors Designed for all
Power Purposes.



OFFICE and MANUFACTORY:
402 and 404 Greenwich Street, New
York City.

New England Office, 19 Pearl St., Boston.

Philadelphia Office, 301 Arch St.

Western Office, 139-141 Adams Street,
Chicago.

Southern Office, 25 Carondelet Street,
New Orleans.

THE American Bell Telephone COMPANY.

95 MILK ST., BOSTON, MASS.

This Company owns the Letters
Patent granted to Alexander Gra-
ham Bell, March 7th, 1876, No.
174,465, and January 30, 1877,
No. 186,787.

The Transmission of Speech by
all known forms of ELECTRIC
SPEAKING TELEPHONES in-
fringes the right secured to this
Company by the above patents, and
renders each individual user of tel-
ephones, not furnished by it or its
licensees, responsible for such un-
lawful use, and all the conse-
quences thereof and liable to suit
therefor.

ESTERBROOK'S STEEL PENS.

OF SUPERIOR AND STANDARD QUALITY.

Leading Nos.: 048, 14, 130, 135, 239, 333

For Sale by all Stationers.

THE ESTERBROOK STEEL PEN CO.,

Works: Camden, N. J. 26 John St., New York.

Wants.

A YOUNG MAN can have lucrative engage-
ment, not only a fixed salary, but accord-
ing to his work accomplished in travelling for
SCIENCE. A personal interview invited.

N. D. C. HODGES,

47 Lafayette Place, New York.

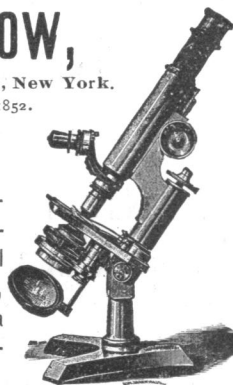
MECHANICIAN.—An optician and maker
of instruments of precision of experience
would be glad of a position where his skill
would be valued in connection with some higher
educational institution. Address G. J., care of
SCIENCE, 47 Lafayette Place, New York.

Scientific Apparatus.

J. GRUNOW,
621 Sixth Avenue, New York.
Established 1852.

MAKER OF

Microscope Stands,
Oil Immersion Object-
ives and Abbe Con-
densers for Bacterial
and Histological work,
of Objectives, Camera
Lucida and other ac-
cessory apparatus.



IMPROVED OIL LIGHT MAGIC LANTERNS.

Also Lime and Electric Light Apparatus, and
mechanical, plain, and fine colored views.

J. B. COLT & CO., Manufacturers,
No. 16 BECKMAN STREET, NEW YORK.

MAGIC Stereopticons and the Best Views
LANTERNS for Public, Church, Home, and
Scientific Exhibitions. Best appa-
ratus, new views. Largest stock. Reduced prices. 24
Years' Practical Experience. Illus. Catalogue Free.

GEO. H. PIERCE,
136 S. Eleventh St., Philadelphia, Pa.

ELECTRICAL TESTING BUREAU,

Johns Hopkins University, Baltimore, Md.

Resistance Coils and Boxes Compared.
Am meters and Volt meters calibrated.
Condensers standardized.
Primary and Secondary Batteries Tested.
Efficiency of Dynamos and Motors Deter-
mined.
Insulation of Cables and Wires Tested.
Etc., Etc.
Circulars describing Methods Used, Prices,
Etc., sent on Application.
Address as above.

MORRIS EARLE & CO.
SUCCESSORS TO

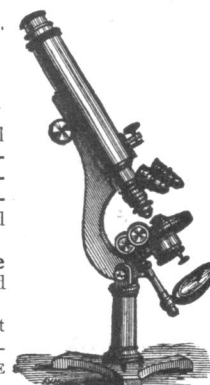
R. & J. BECK,

1016 Chestnut Street Phila

Microscopes and all
Accessories and Ap-
paratus. Photograph-
ic and Photo-Micro-
graphic Apparatus and
Outfits.

Spectacles, Eye
Glasses, Opera and
Marine Glasses, etc.

Illustrated Price List
mailed free to any ad-
dress. Mention SCIENCE
in corresponding with us.



E. & H. T. ANTHONY & CO.
591 Broadway, N.Y.

Manufacturers and Importers of
PHOTOGRAPHIC INSTRUMENTS,
Apparatus and Supplies of every
description. Sole proprietors of
the Patent Detective, Fairy, Nov-
el, and Bicycle Cameras, and the
Celebrated Stanley Dry Plates.

Amateur Outfits in great variety, from \$5.00 upward.
Send for Catalogue or call and examine. More
than 40 years established in this line of business.



GOOD NEWS TO LADIES.

Greatest inducements ever of-
fered. Now's your time to get
up orders for our celebrated
Teas and Coffees, and secure
a beautiful Gold Band or Moss
Rose China Tea Set, Dinner Set,
Gold Band Moss Rose Toilet Set, Watch, Brass Lamp,
or Webster's Dictionary. For full particulars address
THE GREAT AMERICAN TEA CO.,
P. O. Box 289, 31 and 33 Vesey St., New York

A TEMPORARY BINDER

for Science is now ready, and will be mailed
postpaid on receipt of price.

Half Morocco - 75 cents.



This binder is strong, durable and
elegant, has gilt side-title, and allows
the opening of the pages perfectly
flat. Any number can be taken out
or replaced without disturbing the
others, and the papers are not mui-
lated for subsequent permanent bind-
ing. Filed in this binder, Science is
always convenient for reference.

N. D. C. HODGES,

47 Lafayette Place, N. Y.

Readers of Science

Corresponding with or visiting Adver-
tisers will confer a great favor by mention-
ing the paper.

Arnold, Constable & Co.

PARIS MADE SUITS,
Wraps and Jackets,
LACE AND EMBROIDERED DRESSES,
Gaze and Crepe Fabrics
For Evening Wear.

Broadway & 19th st.
New York.

SUMMER DRESSES.

We call attention to the following specialties for this week:

Black and White Striped Armure Royale, at 80 cents; regular price, \$1.15.

Black Satin Princess, \$1; regularly, \$1.25

1,000 yards Pekin Printed Foule at 75 cents per yard, case price, \$1.25.

1,500 yards Figured Bengaline, at 75 cents, former price, \$1.25.

1,750 yards Silk Warp Henrietta, at 75 cents, usual price \$1.

These fabrics are all peculiarly adapted for use at this season of the year.

JAMES McCREERY & CO.

BROADWAY AND ELEVENTH STREET,
NEW YORK.

IMPROVING THE MEMORY PICK

and facilitating the acquirement of knowledge by lectures and correspondence. Classes forming. "MEMORY and its Doctors," from Simonides to "Loisette," mailed for 10 cents.
DR. PICK, 24 Union Square, N. Y. City.

FOOD ADULTERATION

And its Detection. With photomicrographic plates and a bibliographical appendix. By J. P. Battershall. 328 pages, 8vo, cloth. Price, \$3.50. Circulars and Catalogues on application. E. & F. N. SPON,
12 Cortlandt St., New York.



KIMBALL'S STRAIGHT CUT CIGARETTES.

Unsurpassed in quality.
Used by people of refined taste.
Highest award at Brussels, 1888.
The finest smoking mixtures are of our manufacture.
Fifteen First Prize Medals.
WM. S. KIMBALL & CO.,
Rochester, N.Y.

The Mutual Life Insurance Company OF NEW YORK.

RICHARD A. McCURDY, PRESIDENT.

ASSETS - - - \$126,082,153 56

The Largest and best Life Insurance Company in the World.
The New Business of the Mutual Life Insurance Company in 1888
Exceeded \$103,000,000.

Its Business shows the Greatest Comparative Gain made by
any Company during the past year including

A gain in assets of.....	\$ 7,275,301 68
A gain in income of.....	3,096,010 06
A gain in new premiums of.....	2,333,406 00
A gain in surplus of.....	1,045,022 11
A gain in new business of.....	33,756,792 85
A gain of risks in force.....	54,496,251 85

The Mutual Life Insurance Company

Has Paid to Policy-holders since Organization \$272,481,839 82.

PARIS EXPOSITION.

The Cheque Bank issues Cheques, either singly or put up in Books, for the special use of VISITORS to the PARIS EXPOSITION, who can cash the same at upwards of seventy Banking Houses, situated in different parts of Paris, without charge.

Visitors' mail matter can be addressed to them, Care of the Societe Generale, 4 Place de l'Opera, opposite the Grand Hotel, where English is spoken.

Every Cheque that is issued by the Cheque Bank is EQUAL TO CASH, as Bank Notes are, for the Bank's Capital, Guarantee Fund and Customers' Balances are invested in British Government Securities, or held in Cash in the Bank of England, and can be cashed in every town in Europe without charge.

For Handbook containing list of 2,500 Banking Houses who cash the cheques, free of charge, apply to

CHEQUE BANK, Limited,
Capital, £100,000. Guarantee Fund, £27,000.
Trustees, The Right Honorable John Bright, M.P.,
The Right Honorable Earl Beauchamp.
NO. 2 WALL STREET, NEW YORK.

Visitors to Europe and Paris Exposition should carry a book containing Cheque Bank Cheques, which are absolutely safe and cheaper than Letters of Credit, and much more convenient; are payable on presentation without charge at 2,500 Banking Houses and 250 of the principal Hotels in Europe.

A RARE CHANCE FOR A COLLEGE.

For sale—1,300 FINE COINS AND MEDALS, silver, gold, bronze, a history in coins commencing with the fifteenth century, representing over 500 historical persons and 175 countries and cities. Address
L. D., P.O. Box 1337, New York.

Old and Rare Books.

One Million Magazines. Back numbers, vols. and sets—old and new, Foreign and American.
CATALOGUE UPON APPLICATION.

A. S. CLARK,
34 Park Row, New York City.

BACK NUMBERS and complete sets of leading Magazines. Rates low. AM. MAG. EXCHANGE, Schoharie, N.Y.

H. WILLIAMS,

Dealer in Old Magazines, Reviews, &c. Scientific periodicals a specialty. 39 Macdougall St., N.Y.



Readers of Science

Corresponding with or visiting Advertisers, will confer a great favor by mentioning this paper.

WHY YOU SHOULD USE Scott's Emulsion of Cod Liver Oil WITH HYPOPHOSPHITES.

It is used and endorsed by Physicians because it is the best.

It is Palatable as Milk.

It is three times as efficacious as plain Cod Liver Oil.

It is far superior to all other so-called Emulsions.

It is a perfect Emulsion, does not separate or change.

It is wonderful as a flesh producer.

It is the best remedy for Consumption, Scrofula, Bronchitis, Wasting Diseases, Chronic Coughs and Colds.

Sold by all Druggists.

SCOTT & BOWNE, Chemists, N.Y.